TELEPHONE ENGINEER

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COLLECTING FROM THE SERVICE LINES

The collection problem is never an easy one, but many of the smaller telephone companies have a particularly difficult phase of it in dealing with the service lines where the farmers furnish their own lines and instruments, the commercial company merely performing the switching.

Many companies have several hundred such accounts at a charge, taking a country wide average, of considerably under one dollar per month per subscriber. If kept separately, the labor of accounting, billing and collecting each of these accounts is as great as that required for a subscriber who pays many dollars a month. Furthermore, the company does not have the control over the individual station on a service line that it has on its own lines. A delinquent on a company-owned line may be denied service or his line be cut off for non-payment, but this can not be done on a service line.

There is also the individual on the service line who says that he does not use the switching service and, therefore, refuses to pay the switching charge. The commercial company can not force his disconnection from the service line and few of them will deny him service through the switch board in an emergency like a call for a doctor or in case of a death. It can not stop the abuse of service by his calling a neighbor who pays switching charges and asking the neighbor to make a call through the switchboard.

At the present level of switching charges, it is essential that they be collected with as little bookkeeping and collection expense as practicable and that collections be made promptly. Perhaps some company that has been successful in working out a system for doing this can tell us how it is done. It will certainly benefit the many other companies that are still struggling with the problem.

SALE OF DIRECTORIES

The question of policy in the sale of telephone directories to non-subscribers has been discussed recently at a number of telephone meetings. The Board of Directors of the California Association discussed the subject at their May meeting. At a district meeting of the Kansas Independent Telephone Association it was decided to refuse to furnish directories to mail order houses. We are informed that other informal discussions have taken place at various other times and places.

In the past there has been no uniformity in practice in the sale of directories. Some companies have been furnishing directories without charge to anyone who requests a copy or sends stamps to cover postage. Other companies make charges ranging from a nominal amount to a prohibitive price, while still others refuse to furnish directories under any condition.

There is no question that the telephone directory is the most easily obtained and the most up-to-date source of information for the preparation of general mailing lists for circularization. It is also true that much of this circularizing is done by mail order houses in competition with local merchants.

A telephone company supported by local business has much justification in refusing to furnish information to competitors of the local business establishments but, it has been pointed out in some of the discussions, the telephone directory is easily stolen and these agencies, if denied the right to purchase, can easily resort to methods of securing directories without payment.

In view of the value of the directory as a source of information, if it is to be sold, a price commensurate with the value should be placed upon it. This price should be relatively uniform for all companies issuing the same size of directory. It is to be hoped that some definite policy will ultimately grow out of the discussions.

PUBLICITY FOR TRAFFIC FIGURES

A few days ago, a telephone manager said to one of our editorial staff: "By reading the financial pages of the city daily papers I see many reports of railroad freight car loadings with comparisons with figures for other months and years. If I notice that loadings are heavy, I, naturally, am not surprised if an LCL shipment from a point several hundred miles away is delayed somewhat. When one of my large long-distance users complains of delays in

completion of his calls, I may have a general idea that it is because long distance traffic is unusually heavy, but I have no figures to prove my contention. From my standpoint it would be a good thing if telephone traffic figures were given more publicity just as railway traffic figures are now given."

This is a suggestion that would seem to have merit. The American Telephone and Telegraph Company prepares such figures for its own use. Perhaps its information department can arrange so that the figures can be given greater publicity in the pages of papers of general circulation and in the telephone journals.

CONFUSION IN RADIO BROADCASTING FIELD

Much speculation has been aroused recently by the Department of Commerce stating that the Attorney-General says it has very little power to regulate radio broadcasting stations under the antiquated radio law of 1913. Ever since broadcasting has been developed, the department has exercised control over the wave lengths and power of broadcasting stations. It has licensed some 600 stations and has a waiting list of many more which are built and ready to operate, but which have not been able to obtain a license due to the limited number of wave lengths available.

Apparently, the doors now are open for these stations and for others, which have been dissatisfied with their power and wave length assignments, to select their own wave length and power. The department, it seems, has no choice but to issue the license. Some are optimistic enough to think that no great confusion will result, while others of a more pessimistic turn of mind believe that conditions will revert to the confusion that occurred when all stations were operating on 360 meters.

Telephone men are interested in the outcome, as many of them now are or soon may be considering the possibilities of leasing wires for broadcast reception. They are hoping that the liberty granted the broadcasting stations will be used wisely and that speedy legislation providing for an orderly manner of control will be adopted when congress reassembles.

HOLDING COMPANIES — A SUCCESS OR A FAILURE?

Careful observers of conditions in the telephone industry are observing signs of a development which may result in a radical change in the character of the companies in the Independent group. Independent companies have been highly individualistic in character and while associated in district, state and national associations, each company has been an autonomous unit.

Recently there have been formed a number of new holding and management corporations which have been gathering these units into groups and some of the older holding companies have been extending their operations to cover a wider field. Where geographic conditions were favorable, there have been some consolidations of a number of companies into larger units. In the main, however, the companies which have entered the groups under holding company control have retained their identity as operating units.

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The holding company form of organization is not new in the telephone industry. It is almost as old as the industry itself and the largest telephone organization of the world, the Bell System has been built up through its use. The application of this form of organization to groups of companies that previously have been built up and operated as Independent units is recent and it is too early to foresee all the results, either upon the units themselves or upon the business as a whole.

Whether it will be a success will depend much upon the character of the men back of the holding company organization and upon the type of organization adopted. Where the holding companies are officered by men of character and of proved ability as telephone executives; where they are staffed by men of experience in the legal, accounting and engineering phases of the business; where they have adequate financial resources and where the control of the subsidiary companies is such that full advantage can be taken of the benefits, there is no doubt but that the operating units will receive substantial assistance and that improvement in operating and financial results will come.

On the other hand, if the holding companies are lacking in some or all of these essentials but are merely devices whereby security issues may be "dressed up" in order to find a ready market; if they are managed by men whose interest is in the profit that is to be made out of sale of securities rather than the operation of the properties, or who buy and sell for the profit in the turnover, the application of the holding company plan will not result in any permanent benefit either to the operating companies or to the public.

It is an encouraging sign, that several of these companies have been formed by men of standing in the Independent side of the industry.

Typical Toll Line Troubles and Their Location*

By E. R. COLLINS
(*Manitoba Telephone System*)

In Fig. 5 is shown a test desk circuit arrangement for a wheatstone bridge. The one shown in the circuit is a Thompson-Levering dial type. This is a very convenient form of instrument. This is connected for testing to a pair of single cords and plugs to fit the toll line jacks. A key is provided to change the circuit quickly for loop measurement, varley loop measurement, or Murray loop measurement.

The battery supply consists of dry cells connected to a set of standard jacks on the test panel. These provide several voltage taps for different classes of work.

A 110-volt 15-watt lamp is connected in series with the common battery lead. The one shown is a miniature type and is mounted on the face of the test desk. This lamp will protect the coils of the bridge from damage by excessive current. It also gives an indication that the battery key is left locked down, and thus will work a saving on the battery. When a Varley loop or Murray loop is being taken, the lamp will give an indication whether the trouble is on or not. The change in brilliancy of the lamp will indicate when patching changes have been made.

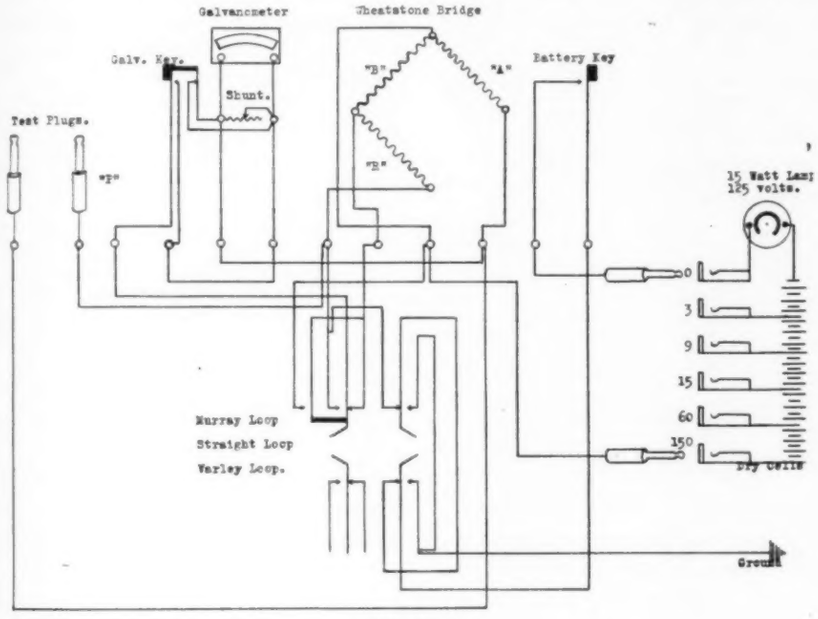


Fig. 5.

The galvanometer of the bridge is provided with a variable shunt, to protect the needle from damage. Never reduce the shunt to zero except for making a final balance of the bridge.

For testing purposes, as high as 150 volts are required for some high resistance troubles. Keep the batteries in good condition, if good results are to be expected.

Principle of Wheatstone Bridge

The principle of the Wheatstone bridge may be planned by the use of an analogy. In Fig. 6 is given a rough floor plan of a theater or church. The people are coming out of the building. Four people can walk abreast up aisles X and R. The entrance to the halls A and B are through doors L and M. There is a gate at K and a passage G from L to M. One of the doors at L has not been opened, so that the people cannot get out into hall A. An usher opens the gate K and allows part of the crowd to pass through passage G and out door M. On account of the extra width of the hall A the people get out. Now had door L been open, the people coming up aisle X could have gone out hall A since it is the same width as hall B. There would have been no inducement for any one to go through G since it was much longer. Now if an equal number of people are coming out through X and A and out through R and B, and no one coming through G we can call the traffic balanced.

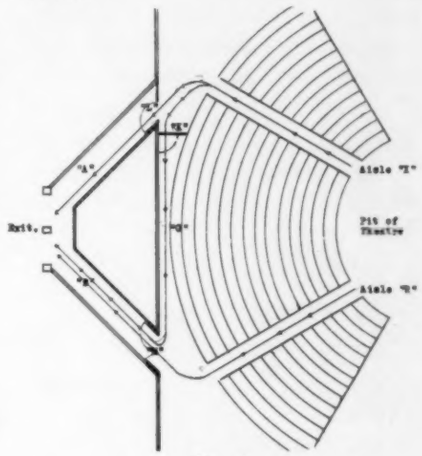


Fig. 6

Suppose 1000 people came up aisle R and out hall B, and 1000 came out hall A and no one crossed through G, then we know there must have been 1,000 people who came out X. We could call X in this case an unknown quantity which we found out by the number coming out A and B.

In Fig. 7 we have replaced the theater with a set of coils, A, B and X, R. We allow the current to flow from point P through X and R, then through A and B to point E and out to the battery.

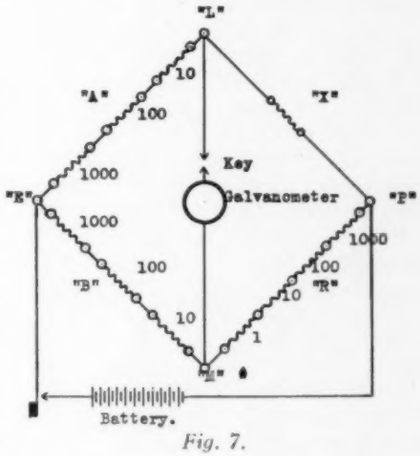


Fig. 7.

Then we have the key and the galvanometer to replace the gate and the aisle G in Fig. 6. Let the coils A, B and R each equal 1,000 ohms, and assume there

Continued from July issue TELEPHONE ENGINEER.

is no current flowing in G. Then we can know that the value of X must be the same as R, or 1,000 ohms.

Then assume that:

A = 1,000 ohms
B = 1,000 ohms
R = 300 ohms

Then

X = 300 ohms

when we have no current flowing through the galvanometer. From this we assume that the relation of A is to B as X is to R or A:B as X:R. We call the two outside letters A and R the extremes, and the two inside letters B and X the means.

Multiply the means by the extremes and we write it down $(B \times X) = (A \times R)$. But in the above

B — 1,000 ohms
A — 1,000 ohms
R — 300 ohms

Substitute the values for the equation and we have:

$$(1{,}000 \times X) = (1{,}000 \times 300)$$

or

$$1{,}000X = 300{,}000$$

or

$$1X =$$

300,000 divided by 1,000 equals 300

All the above steps can be condensed into the following, where the letter X stands for the unknown resistance: *X equals the product of A multiplied by R and divided by B.*

Assuming another example, let A equal 100, B equal 1,000, R equal 500, find X.

$$X = \frac{A \times R}{B}$$

$$X = \frac{100 \times 500}{1{,}000}$$

$$X = \frac{50{,}000}{1{,}000}$$

$$X = 50 \text{ ohms}$$

The arms A and B are called the ratio arms and usually consist of four coils each. For each arc there is a 1 ohm, 10 ohm, 100 ohm and 1,000 ohm coil, arranged so that any one can be used. The arm R consists of four sets of coils. There are nine 1 ohm coils, nine 10 ohm coils, nine 100 ohm coils and nine 1,000 ohm coils so arranged that any combination of resistance can be set up.

In some types of instruments the battery and galvanometer keys are so arranged that the battery key closes first, and then the galvanometer key, while the galvanometer key breaks first, and then the battery key. This is done to prevent the back kick from the line or coil, deflecting the needle of the galvanometer. The galvanometer is connected and disconnected while the battery current is still flowing. Where two separate keys are provided, follow this sequence of operation of the keys. When measuring some types of apparatus, the back kick would be so bad that the galvanometer needle might be broken.

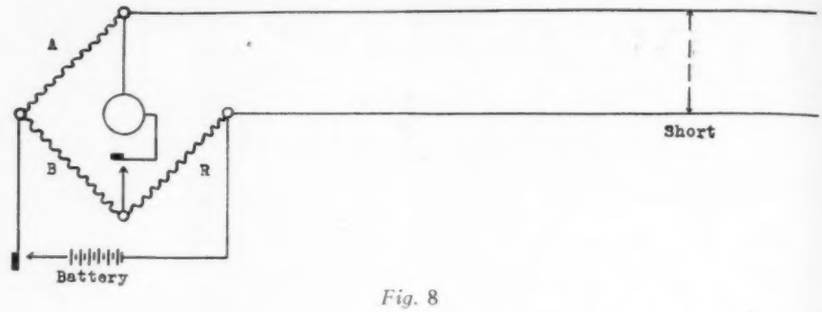


Fig. 8

Measuring the resistance of coils of wire should be done with the current at the lowest voltage possible, and allow the current to remain on for very short periods. The heating of the coil caused by the current flowing will change the resistance reading.

Toll Line Troubles

Toll line troubles can be classified into the following general groups:

1. Short circuit.
2. Ground.
3. Swinging short circuit.
4. Crossed lines.
5. Loose connections.
6. Open lines.
7. Cross talk on phantom lines.
8. Ringing troubles.

Short Circuit

To measure a short circuit, set up connection as in Fig. 8.

Where the Varley key is used as in Fig. 5, have the key normal. With arms A and B each 1,000 ohms, balance the bridge so there is no current flowing in the galvanometer, and assume the value of R is now 350. Then apply the following formula:

$$X = \frac{A \times R}{B} = \frac{1{,}000 \times 350}{1{,}000} =$$

$$\frac{350{,}000}{1{,}000} = \frac{350}{1}$$

Then X is 350 ohms.

Suppose there is cable between the test desk and the open wire, and the resistance of the cable is 30 ohms.

Subtract the cable resistance from the resistance to the trouble and we have 320 ohms from the end of the cable to the trouble. Suppose the line wire is No. 10 B. & S. copper wire. This is 10 ohms per mile for a metallic circuit at 46° Fahrenheit. Then the distance to our trouble from the cable box will be 32 miles at normal temperature.

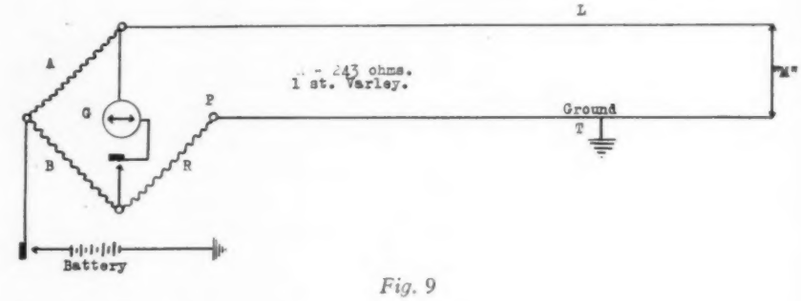


Fig. 9

Grounded Line

To measure the distance to the trouble of a grounded line set up the connections as in Fig. 9, with the bridge key in the Varley position if this key is used. Have a short circuit plug inserted in the test jacks of line at exchange M. Balance the bridge till there is no deflection of the galvanometer. Suppose the arms A and B are each 1,000 ohms, and R balances at 243 ohms. The resistance lamp

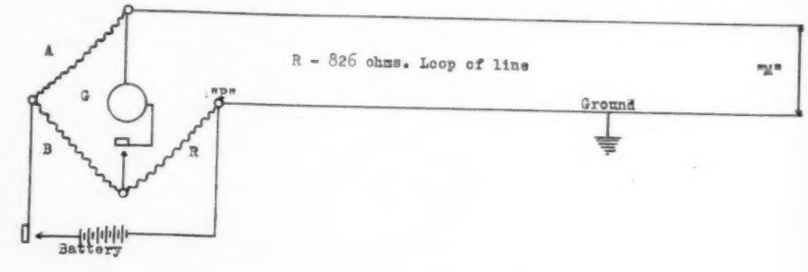


Fig. 10

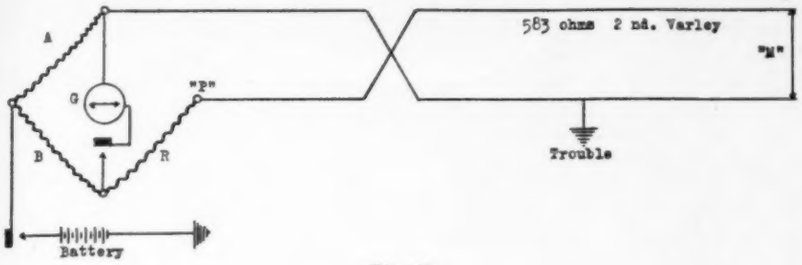


Fig. 11

will indicate the presence of the trouble. In this case we obtain a balance with the unknown X consisting of the section of line from A to T, and arm R consisting of its own resistance and section PT of line. Now section AL equals section PT, since both are the same length.

Therefore taking these two sections away, we have left arm R and section LMT. Section LMT takes the place of X. But X equals 243 from the equation.

$$X = \frac{A \times R}{B} = \frac{1{,}000 \times 243}{1{,}000} = 243 \text{ ohms}$$

Therefore section LMT equals 243 ohms.

But section LMT is twice the distance from M to trouble at T.

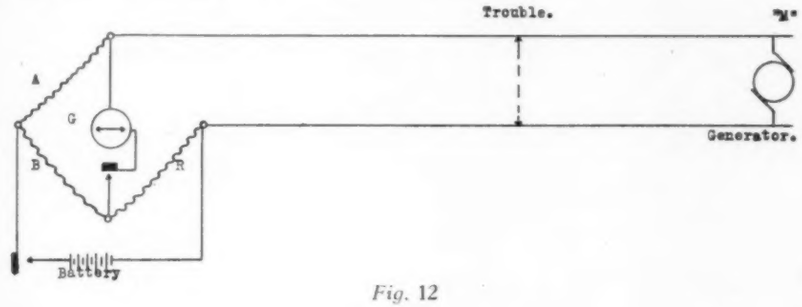


Fig. 12

Therefore one half LMT is 243 ohms, divided by 2 equals 121.5 ohms. No. 10 copper wire is 5 ohms per single wire per mile. Therefore 121.5 divided by 5 equals 24.3 miles from M to trouble T.

This can be summarized as follows: *The reading of R divided by the resistance of the metallic line will be the distance of the trouble from M.*

Ground Line Check Measurement

Where absolute accuracy is required, the following check method of measurement is used:

Set up connections as in Fig. 10.

With Varley key normal, measure the resistance of the line to short circuit plug at M. Let the reading be 826 ohms.

Set up connections as in Fig. 9 and balance the bridge with ratio arms each 1,000 ohms. Let the reading equal 340.

Set up connections as in Fig. 11, and balance the bridge with arm A 100 and B 1,000 ohms, and let the balance of arm R be 1830 ohms.

Let A equal arm A, B equal arm B, r loop of line to M, R reading of arm R of bridge.

To obtain the distance from P direct to trouble:

$$\frac{(B \times r) - (A \times R)}{A + B}$$

1. Multiply 1,000 by 826 equals 826,000.
2. Multiply 1,000 by 340 equals 340,000.
3. Subtract equals 486,000.
4. Add 1,000 plus 1,000 equals 2,000.
5. Divide 486,000 by 2,000 equals 243 ohms.

This is the distance from P to trouble. This is shown by the formula, which we will call our first Varley.

$$\frac{(B \times r) - (A \times R)}{A + B}$$

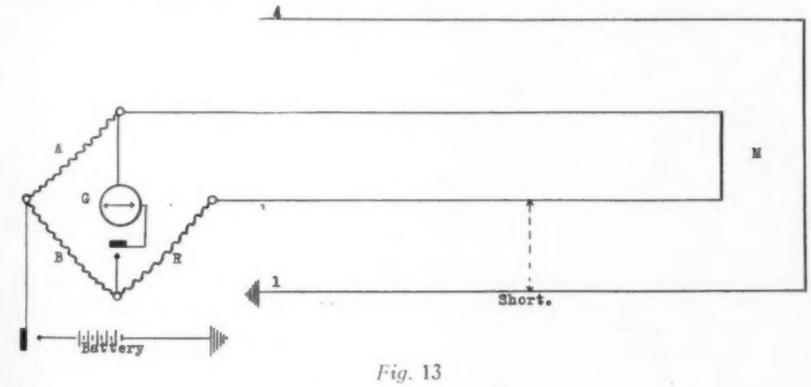


Fig. 13

or

$$\frac{(1{,}000 \times 826) - (1{,}000 \times 340)}{1{,}000 + 1{,}000}$$

or

$$\frac{826{,}000 - 340{,}000}{2{,}000}$$

or

$$\frac{486{,}000}{2{,}000} = 243 \text{ ohms}$$

Reverse the test plugs and balance the bridge. To obtain the distance from P to trouble as in Fig. 11.

1. Multiply 1,000 by 826 equals 826,000.
2. Multiply 100 by 1,830 equals 183,000.
3. Subtract 643,000.
4. Add 1,000 and 100 equals 1,100.
5. Divide 643,000 by 1,100 equals 583 ohms from P to trouble as in Fig. 11.

This is shown in the formula, which we call the second Varley:

$$\frac{(B \times r) - (A \times R)}{A + B} =$$

$$\frac{(1{,}000 \times 826) - (100 \times 1{,}830)}{100 + 1{,}000}$$

or

$$\frac{826{,}000 - 183{,}000}{1{,}100}$$

or

$$\frac{643{,}000}{1{,}100} \text{ is } 583 \text{ ohms}$$

Now if we add the first Varley 243 ohms and the second Varley 583 ohms, we have a total of 826 ohms, which is the total resistance of the loop of the line to M. Therefore we know our measurement is correct and can compute the distance from either end of the line.

Lest we forget it, if the plug connected to the X or outer end of arm R is marked some special color, and the previous check method is used, we can always know that the working out of the equation will always give the distance from the plug P to the trouble. Paint the plug some special color so that you will not need to refresh your memory each time you use this measurement.

Swinging Short Circuit

It is frequently impossible to measure a short circuit accurately when the resistance of the trouble is high and intermittent. It is sometimes possible to measure such a trouble by setting up the connections in Fig. 12. Have the operator at the distant exchange ring steadily on the line while the measurement of the loop is being made. Care must be taken not to remove the galvanometer shunt entirely or the needle may be broken. Where this method is not practical, set up the connections as in Fig. 13. In this case we have the bad line and a good line connected together at exchange M.

One side of the good wire and one of the bad wire are connected to the bridge. Make a measurement of the loop of wires 2 and 3 to make sure the resistance is about right for the length of wire. Ground the other bad wire and then proceed to make the check Varley measurement for a ground. In this test it is not necessary that the two lines be of the same wire or gauge, so long as you have the plug P marked. In such a case the lowest resistance Varley measurement will be the distance to the trouble on No. 2 wire.

Fig. 13.

Another case of a swinging short circuit is shown in Fig. 14. Here we have no direct good line from exchange M to make the Varley loop connection. So we build up a circuit through exchanges M, N and Q and back to the test desk again. Here again the size or kind of wire we are using for the return test does not matter, since we work out the formula to give the distance from the plug P to the trouble. Here again the check method can be used to prove our measurement.

Fig. 14.

Lines Crossed

To measure the distance to a cross between two lines, set up connections as in Fig. 15. Short circuit one line at exchange M, and ground the other line either at your own test panel, or at the M exchange panel. Then proceed as in Fig. 9, 10 and 11 to measure the ground on the short circuited line.

Fig. 15.

Lines Crossed Between Distant Exchanges

In Fig. 16 is shown a case where there is only one line available from exchange M to test point, but two lines are crossed beyond this point. Set up the connections as shown in Fig. 16, having one line short circuited at exchange N and ground the other line at either exchange M or exchange N. Then proceed to take a Varley loop measurement, using the check method for accuracy.

Fig. 16.

Open Test

Fig. 17.

In Fig. 17 is shown the connections for testing an open line with the test circuit shown in Fig. 4. Test the line for ground by throwing the voltmeter key, and ground, and then the reverse key for ground on the other side. To make sure that you have one good wire to exchange M have a ground put on at M and see if you get this on the one wire. Then have an open plug put in at M.

Now throw voltmeter, open 1, open 2 and ground keys. This throws the reversing relay into operation, causing the one wire to charge and discharge, and the deflection of the voltmeter is read and marked down.

Next throw the reverse key in addition to the others, and read the capacity of the other wire. The good wire will be found to have the highest reading, unless the bad wire is touching another line clear of ground.

Assume reading of good wire is 32, bad wire is 22, length of good wire 30 miles. Deduct capacity of your cable which we will call 8, then 32—8 equals 24 and 22—8 equals 14. Then 24 equals 30 miles, 1 equals 30 divided by 24, 22 equals $\frac{30 \times 22}{24} = 17.5$ miles from cable box to break in the line.

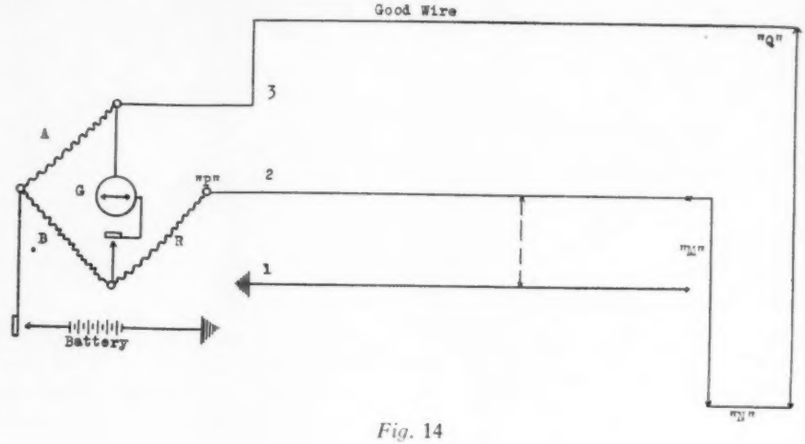


Fig. 14

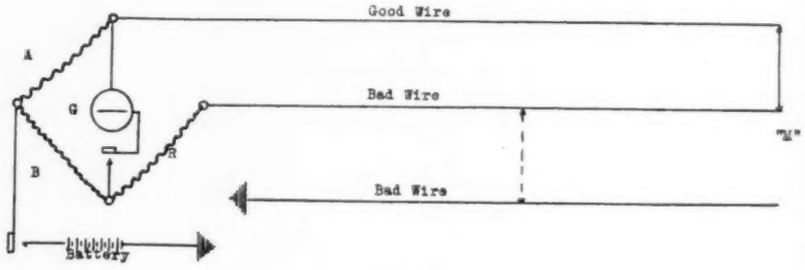


Fig. 15

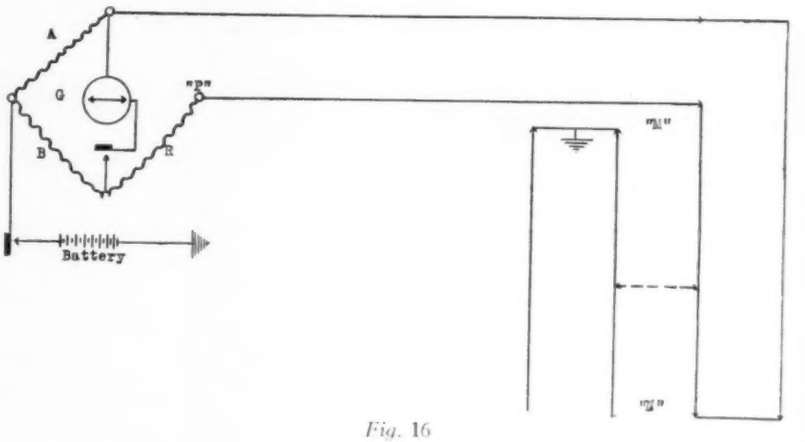


Fig. 16

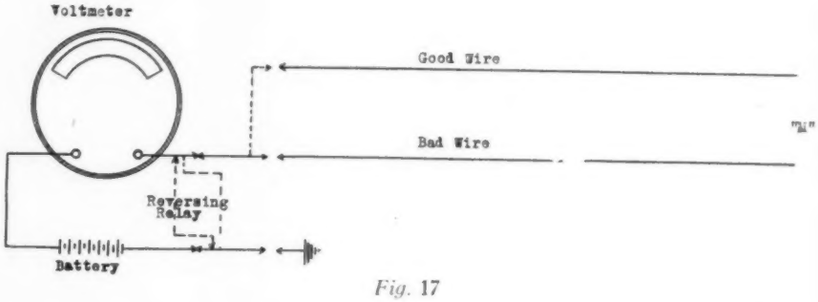


Fig. 17

Checking Resistance of Wires

It often happens that lines which have a similar loop resistance may have a variation between the individual wire re-

sistances. To check the resistance set up the connections as in Fig. 18.

Have all the wires bunched at distant exchange.

Letter the four wires, A B C D.

Measure the following:

A + B = 200 B + C = 200
A + C = 200 B + D = 200
A + D = 200 C + D = 200

Solve for resistance of A:

A + B and A + C = 200 + 200.

2A + B + C = 400.

But B + C = 200.

Then 2A must equal 400 — 200 = 200.

Therefore 1A equals 200 divided by 2 equals 100 ohms.

Solve for resistance of B, take:

A + B and B + C = 200 + 200.

Solve for resistance of C, take:

A + C and B + C = 200 + 200.

Solve for resistance of D, take:

A + D and C + D = 200 + 200.

Phantom Line Troubles

Cross talk and cross ringing on phantom lines may be due to one of several causes. Some of the causes of trouble with this type of a circuit are here given.

1. Difference in resistance of the physical wires.
2. Unbalance in capacity between wires.
3. Ground on either physical line.
4. Improper transposing of physical lines or the lack of transposing.
5. Defective repeating coils.
6. Tree leakage or broken insulators.
7. Loose connections on physical lines.
8. Physical lines carried through long cables.

Resistance Difference

To check the resistance of the four wires used for a phantom circuit, follow the scheme shown in Fig. 18. Use as low voltage battery as will give correct reading on the bridge for this test.

Capacity Difference

For a difference in capacity, use the open test on each wire and record carefully the capacity of each. Any difference may be due to defective cable pairs, crossed with short local lines, or dead lines.

Ground or Tree Leakage

For location of ground or tree leakage proceed as in the tests for grounds.

Transposing

One of the most important things to do is to have physical lines properly transposed, and also special phantom transpositions on heavily loaded lines. For a complete scheme of transposing refer to your engineering department. If you have no engineering department, telephone journals or supply houses will give information on request.

It is difficult or impossible to work phantom lines through long cables without cross talk. A special type of cable known as a quadded cable is used for this purpose. Where only one phantom circuit is carried through the cable the results may be fair, but where two or more are present the cross talk will be very bad, depending on the length of the cable and the line.

Loose Connections

The handling of loose connections calls for some care and quick action. When a loose connection is noticed, remove the line from service. Then by having the operator at some distant exchange talk to you on the defective line, locate the trouble between exchanges. Care must be taken not to ring on the circuit or use testing battery, as you might burn the

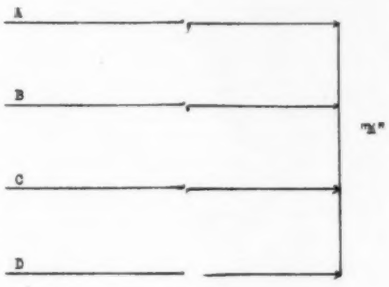


Fig. 18

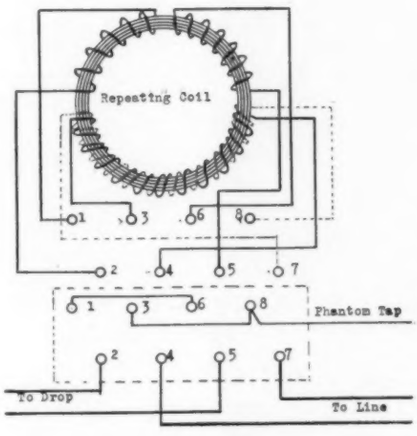


Fig. 19

trouble off. When the trouble has been located between two test points, about the only thing to do is to send the troubleman out about half way between the two exchanges, and place a short circuit on the line. Connect the toll line to a long good cable pair, and the noise resulting from the trouble will be intensified.

When the short circuit kills the noise entirely with the tester listening, the trouble is past the troubleman. When the noise is diminished by the short, the trouble is between you and the troubleman.

Phantom Repeating Coils

Phantom repeating coils are marked by the manufacturer, to show the proper way to connect to the lines. The phantom circuit is built up by taking a tap out of the exact center of the line windings of the repeating coil. In Fig. 19 is shown the scheme of construction of a repeating coil. The windings for the line coils are wound on together as one wire should be. The two wires forming the line coils, are bound together by a light floss cover, and then wound on as one wire. This prevents any difference in the character of the two coils, and gives the exact center of the coil. Always connect up the phantom coils as shown in Fig. 19 with the line to the line coils, and the switchboard to the drop coils. Unless this is done cross talk will likely result.

Wire Gauges, and Resistance

Below is given a table of wire gauges and the change of resistance for different temperatures.

	No. 8 B&S copper.	No. 10 B&S copper.	No. 8 BWG copper.	No. 8 NBS iron.	No. 12 NBS iron.
100..	3.527	5.606	2.141	22.17	41.69
90..	3.459	5.498	2.099	21.65	40.71
80..	3.391	5.389	2.058	21.13	39.74
70..	3.322	5.28	2.016	20.62	38.77
60..	3.254	5.172	1.975	20.1	37.8
50..	3.186	5.063	1.933	19.59	36.83
40..	3.118	4.955	1.891	19.09	35.86
30..	3.049	4.846	1.85	18.55	34.89
20..	2.981	4.737	1.809	18.03	33.91
10..	2.913	4.629	1.767	17.52	32.94
Zero..	2.844	4.52	1.726	17.00	31.98
10..	2.776	4.412	1.684	16.48	31.00
20..	2.707	4.303	1.643	15.96	30.02
30..	2.639	4.194	1.603	15.45	29.06
40..	2.571	4.086	1.56	14.93	28.08

The above table is for new wire. Where wire has been up for some years, the resistance will likely be higher. In such a case, measure the resistance of a line for a known distance at the temperature prevailing and compute the resistance per mile from actual measurement. For ordinary work the above table will be quite an assistance.

In this article we have just touched on these points which occur most commonly in the daily work of a wire chief. It is hoped that there may be some information that will be of assistance to some one in performing his daily task.

Scherer and "Hubie" Frame Many Meets for "Sooners"

Oklahoma City, Okla.—L. W. Scherer, chairman of the telephone division of the Oklahoma Utilities Association, and H. W. Hubenthal, engineer for that organization, have scheduled 12 district meetings for the state to be held during September. An invitation is extended to equipment men and telephone men from neighboring states to attend these sessions.

The schedule:

Yale, Sept. 6; Barnsdall, Sept. 7; Wagoner, Sept. 8; Hanna, Sept. 9; Sulphur, Sept. 11; Comanche, Sept. 13; Roosevelt, Sept. 15; Hydro, Sept. 16; Kingfisher, Sept. 17; Watonga, Sept. 20; Fargo, Sept. 21; Texhoma, Sept. 23.

"I", Not "We" Keynote of Dallas Repair Plan*

Careful study of telephone service, to get the subscriber's viewpoint, has inspired a system-wide effort to improve our contacts with the public. The plant department has accepted its share of this effort. Renewed attention to construction and maintenance work, with particular attention to what is known as preventive maintenance, has by this time brought reports of improved conditions from all state headquarters.

This article will deal with Dallas, however; partly because the effort of the Texas plant department has brought results of which the state organization is proud and partly because in the city of Dallas certain plant department practices have been developed to a point that makes them worthy of detailed consideration.

Between the first of October, 1925, and the first of February this year, the rating of the Dallas plant department was improved from 60 to 147. This improvement was the result of a concerted effort of outside repairmen, construction forces, cable splicers, substation installers, central office repairmen and desk men to better service conditions. Dallas plant headquarters had its share in the work and made several changes to improve the department routine with the subscriber's viewpoint in mind.

The repair clerk deals with subscribers whose service has failed and is the most delicate point of contact between the plant department and the public. Therefore, the repair clerk's job was most affected by these changes in practice. Indeed, people outside the company, finding that Dallas has a new system for handling calls to the repair clerk, probably think that the improvements began and ended there, which is not the case, of course. This new system is only one result of the Dallas effort. It is true, however, that the best place to get an idea of what has been accomplished and of what is being done in Dallas is in the repair department.

Let us see what happens there and find out why. We will then be in full possession of the Dallas plant department's rather interesting story.

We can show best by comparison. A year ago, if a subscriber wanted to report trouble and called the repair clerk, something like this happened:

"Repair clerk."

"Hello, repair clerk, my telephone won't ring. People tell me they have tried to call but the bell doesn't ring."

"What is your number, please?"

"X-110."

"Your bell doesn't ring. What is the name, please?"

"George Ripley."

"Will you give me your address?"

"Two fifteen Akard street."

"Thank you, Mr. Ripley, we will take care of it."

That was an average case. If the subscriber was angry, the repair clerk was in a trying position, as she soon ran out of phrases wherewith to answer him. The phrases she used were vague. It didn't help much to say "we will take care of it." The person reporting trouble at once felt that he was dealing with a huge, impersonal organization. He believed his complaint would be passed from desk to desk. He would be lucky, in that case, if it wasn't pigeonholed and forgotten.

When the ideal of service from the subscriber's viewpoint was voiced, the weakness of the repair clerk's practice was seen throughout the Southwestern System. It was evident that it was not wholly adequate. Or at least evident that it might be improved. Dallas must have the credit for supplying a good solution to the problem of improving that work.

Today's Method

Here is what happens today when a subscriber reaches the repair clerk to report trouble:

"X Repair Department."

Note: She says "department," not "clerk." This is important. The subscriber is made to feel that he is talking with the people who attend to the repairs. That is what he wants. He doesn't want a "mere clerk" to make a report of his report. He is in trouble and wants attention.

"My telephone won't ring. People try to call but it don't ring."

"What is your number, please?"

"X-110."

"Is this Mr. George Ripley?"

(For she has the X office line cards available and she pulls Ripley's card as his number is given. She does this for the specific purpose of calling back his name.)

"Yes—how in the world did you know my name?"

"I have a record card here, Mr. Ripley. Your address is two fifteen Akard street, is it not?"

"That's right."

"Thank you, Mr. Ripley. I will have your telephone fixed by three o'clock this afternoon."

Note: She says "I" will have it fixed, not "we." The reason for this is the same as for "department" instead of "clerk."

"Well, that's fine. I'm expecting a long distance call this evening and that will be plenty of time for it."

This last remark by Mr. Ripley is one that often comes, by the way. Or something like it. But suppose it doesn't come. Suppose Mr. Ripley says:

"Well, I wish you would have it fixed by three o'clock because my wife is very ill and we have to run next door to call up the doctor. He gave the nurse orders to do that."

Then the repair clerk says:

"In that case, I will send the first repairman that reports to me to your house, Mr. Ripley. You can be sure of service within an hour."

Or, suppose another case. Suppose Mr. Ripley reports his telephone out of order. Can't call or receive calls. Suppose it is due to a damaged cable. The repair clerk has been notified of this and she says:

"There was a fire at 100 Akard street last night, Mr. Ripley, and it melted a cable connected to your telephone. Our men are working on it and it will probably be in service by five o'clock this evening."

Now, put yourself in the subscriber's shoes. Which treatment would you prefer? Wouldn't it please you immensely to have the repair clerk call back your name immediately? Wouldn't it make you feel that the telephone company was efficient, was on the job and interested in you? Wouldn't you be pleased to have an explanation of your trouble at once, or better, a definite time set for clearing it?

Time Allowances

In Dallas today there is a standard three hour appointment for the repair of residence stations. For business, the allowance of time is two hours, with one hour for ordinary P. B. X. troubles. All central office troubles are cleared within forty-five minutes. The testboard tests and makes a report on all troubles within fifteen minutes.

Sometimes the subscriber's lines are tested while he is talking to the repair clerk and if it is found that the trouble calls for a repair inside the central

*From Southwestern Telephone News.

office it is cleared immediately. The subscriber, while talking about a line out of order, is told, "We have found the trouble here in the office, Mr. Ripley, and it is fixed. Your line is working now."

How are these results achieved? By the operation of a changed organization, which lines up as follows:

1. The division plant superintendent is at the head and has supervisory duties only.

2. Under him is the wire chief supervisor, who is in active command of the repair organization.

3. Under him is a new official, the service supervisor, who keeps track of the activities of

A. The testboardmen, who test troubles and dispatch repairmen to the job.

B. The repair clerk supervisor (also a new official), who supervises all repair clerks.

The service supervisor is the king pin of this particular organization. From the testboardmen he learns what troubles exist and supervises the dispatching of repairmen so that he always knows what men are working and where. He gives this information to the repair clerk supervisor, who passes it to the repair clerks.

And that is why the clerks are able to say immediately whether the trouble reported is due to cable failure or not. Also, that is why they are able to set a definite time for the repair of a trouble. The organization is kept large enough to make residence repairs within the three hour limit set, but sometimes troubles are light and men are available. Then the service supervisor and the repair clerk supervisor pass the word that immediate attention can be given. Or that one hour is the limit and not three.

Sometimes, too, there may be an emergency and the three hour limit cannot be observed. Then the time is set at four or five hours, if necessary. The important thing is to set a time and live up to it. Most trouble calls are not urgent and the full effect of this system is obtained if Mr. Ripley is told that his telephone will be fixed by five o'clock, instead of three, if that is necessary.

On the average, however, the three hour limit is never exceeded. Much more often it is cut to one or two hours.

The service supervisor has other important duties. He analyzes chronic or repeated complaints and takes whatever action is necessary, in his judgment, to permanently clear the trouble and to satisfy the subscriber. Frequently, the service supervisor personally calls the subscriber on difficult cases, getting a detailed history of the trouble from the subscriber's viewpoint, which usually gives pertinent facts which help locate the source of the trouble. After such trouble is cleared, the service supervisor follows up by calling the subscriber at intervals of four or five days for a week or two to see that satisfactory service is being received.

Repair Clerk Supervisor

The repair clerk supervisor is another important figure in this organization.

The repair clerks for the city of Dallas are grouped at a set of turret tables. The testboards are across an aisle, some ten feet from the turrets. There are four repair clerks on duty normally, with reserves available in the plant department clerical force.

Each clerk on duty has within reach the line cards of two central offices, so that she can pull cards as soon as she gets a subscriber's number and make intelligent reference to them during the conversation. She will not answer if the cards are not available. The turret lights flash in different colors, red for X office, green for Haskell, and so on. When the clerk at the first position sees a red light flash she knows that she can take the call for the cards are within her reach. If it is a green light, she knows the Haskell cards are two positions away and someone else must handle the call.

The repair clerk supervisor takes a position so that she can oversee all clerks, just as a central office supervisor oversees a certain length of switchboard. She is always on hand to assist the clerks. Sometimes, when a subscriber is particularly angry or impatient, she undertakes the diplomatic job of satisfying him, thus releasing the clerk for other calls. Or she may plug in if the clerks are overloaded, which rarely happens.

Also the repair clerk supervisor keeps in touch with the service supervisor and passes on his information to her clerks, such as: "Haskell can promise immediate repairs." "The X time limit has been reduced to two hours." "There is a cable failure and numbers so and so to such and such are affected." And so on.

When there is a cable failure, however, all line cards affected will be pulled from the files and given to a special reserve clerk at an extra position. Then the special clerk will handle all calls relative to the cable trouble.

Phrases

An important point in connection with the work of the Dallas repair clerk is that she has only a few routine phrases to use in replying to a subscriber. Clerks are chosen for their ability to make quick, original replies. They are made responsible officials of the company and are allowed to talk as such and impress the subscriber with the fact that he has reached someone who has full authority to take care of his complaint. He need go no further. He has found someone who will see that repairs are made.

An effort is made to use everyday language as much as possible. "I will have that fixed by three o'clock." They do not say "repair," which is somewhat harder to understand. They do not say "We will take care of it." One objective of the entire Dallas plant organization is to permit the repair clerk to say "I" instead of "we" and to be definite.

Another point. After repairs are made, the subscriber is notified. This is sometimes done by the clerk, but more often by the repairman. "Your telephone is working now." If it is a central office repair, the wire chief or testboardman gives the message.

If a repair is promised by three o'clock in the afternoon and it develops that the trouble is due to a hitherto unknown cable failure, the repairman will call at the house or office in person to explain the delay in completing the repair.

It might be thought that this plan caused a costly increase in the Dallas maintenance force. To make repairs on schedule seems to require more maintenance men. However, the Dallas plan was brought to its present point of operation with the following additions to the regular organization:

One service supervisor, taken from the regular plant organization.

One repair clerk supervisor, taken from traffic, as her work is similar in many ways to that of a traffic supervisor.

One additional repair clerk.

One additional testboardman.

Two additional outside repairmen.

All of these additions were not permanent. We quote from a report recently forwarded from Dallas:

"The additions to the force were made at the beginning of this effort in October. We were then having an average of 19,600 complaints per month, 4,500 troubles, with 57,500 stations. At the end of February, complaints had been reduced to approximately 10,000 per month, troubles to 2,400, and the total stations had been increased to 61,354. This was a net reduction of 9,600 complaints monthly, 2,100 troubles, with an increase of 3,450 stations.

"The additions made in October were essential to the success of the campaign based on the number of complaints and troubles experienced at that time, but with the improvements realized through the five-month period, we have been able to withdraw all of the additional people except the service supervisor and the repair clerk supervisor, leaving a net addition of two employes, with which force we are now doing the job on the improved basis, at the same time having gained 3,450 stations.

"This was accomplished simply by the elimination of repeated troubles; in other

words, by clearing troubles on the first attempt, which eliminated multiple complaints and visits as experienced in the past."

Teamwork

While the new method of handling subscriber's reports by the repair clerk has resulted in improved public relations and more efficient handling of reported troubles by testboardmen and, through them, by the repairmen, it must be kept in mind that the improvement of the Dallas service rating has been primarily due to the teamwork of all parts of the maintenance and construction organizations. When the study of the plant job, from the subscriber's viewpoint was decided upon last October, meetings were held by each plant department group, at which the objectives of the company were explained and suggestions were asked for and received from the men.

Outside repairmen, construction forces, cable splicers, substation installers, central office repairmen and testboardmen all enlisted in the effort for improved service. The various groups made a concerted effort to reduce service interruptions and troubles and also to clear more efficiently whatever troubles were reported. Men were sent out routining outside plant, removing and remedying defective conditions.

Exchange repairmen were given intensive training in the proper methods of clearing and preventing troubles. Cable splicers began to view their jobs from the service standpoint, particularly where transfers and cutovers were involved. The work of the station installers was checked up and a marked improvement made in the manner of installing stations, drop wires and line wires so that the possibility of future trouble was minimized.

Following rainstorms, lists of all line circuits which showed permanent and later came clear while drying out, were given to special cleanup men who went out and replaced defective drops and line wires.

E. L. Smith, division plant superintendent, directed the organization of the new Dallas plan. He presided at several meetings of the maintenance organization when it was first conceived and explained what objectives were desired.

Jack Bridgeman, division maintenance supervisor, has been in active charge of building the present organization.

The new position of repair clerk supervisor was filled by Mrs. Violet E. Keith, who changed from the traffic department.

The new position of service supervisor was filled by J. M. Glaze, formerly wire chief at Fort Worth.

E. S. Bloom Now Western Electric President

New York City—Edgar S. Bloom, a vice-president of the American Telephone and Telegraph company, has been elected president of the Western Electric company, succeeding Charles G. DuBois, who has been president for the past seven years and who continues with the company as chairman of the board of directors. The company's increasing activities and Mr. DuBois' variable health led him to ask to be relieved of part of his responsibilities.

E. S. Bloom

Mr. Bloom is a graduate of the engineering department of the University of Pennsylvania where he also took a postgraduate course. Starting in the engineering department of the New York Telephone company, he has had a wide experience in engineering, construction, commercial and executive capacities with several of the associated companies of the Bell system. Before becoming vice-president of the American Telephone and Telegraph company, a position which he now resigns, he was chairman of the board of directors of the Indiana Bell and Ohio Bell telephone companies and vice-president of the Illinois Bell Telephone company.

Woolfolk Made Directory Sales Supervisor at Lincoln

Lincoln, Neb.—R. M. Woolfolk, recently with the R. H. Donnelly Co. of Chicago, as telephone directory specialist, and recognized as one of the leading authorities in this line of work has been appointed to fill the new position of directory sales supervisor by the Lincoln (Neb.) T. and T. company.

Erin, Tenn.—A. P. Vaughn, Allensville, has bought the Houston County Telephone company, which he will rehabilitate.

C. G. Stoll Elected Western Electric Vice President

New York City—Clarence G. Stoll, general manager of manufacture of the Western Electric Co., has been elected a vice-president to succeed the late H. F. Albright. Mr. Stoll formerly was manager of the Western Electric Hawthorne Works in Chicago. He began with the

C. G. Stoll

company 23 years ago as a student engineer in Chicago. He has been head of the apparatus design department, in charge of the engineer of methods department of the New York shops, head of the manufacturing branch, shop superintendent of the Western Electric Antwerp factory, assistant general superintendent of Hawthorne in 1920 and works manager prior to his appointment as the W. E. general manager of manufacture.

George E. McFarland, Pioneer, Eulogized by Old Pal

New York City—A simple and sincere document entitled "A Pioneer—George E. McFarland," has been put into circulation by the Telephone Pioneers of America. It is the story of the career of the late chief of the Bell interests on the Pacific coast and was written by C. E. Hall, who was a bosom companion of McFarland's in the days when they both were with the Bell in Iowa. It is one of the most inspiring human tales of the typical able telephone pioneer and is certain of wide and favorable reception.

Plattsburg, N. Y.—Lawrence E. Croake, for several years general auditor of the Northern New York Telephone Corporation, has been appointed that company's secretary-treasurer to succeed the late George H. Rymers.

Magnetism Is Basic Study for Telephone Man*

By F. J. DOMMERQUE
(*Fellow A. I. E. E.*)

18. Magnetic Attraction and Magnetic Induction

Many years ago near the town of Magnesia in Asia Minor an iron ore was found, which showed the peculiarity of attracting small particles of iron held near to it, and of holding them when brought into contact with it. Subsequently this property of attraction and adhesion was named "Magnetism" after the place of discovery of the magnetic ore. By taking a bar of iron and rubbing it with the edge of a piece of magnetic ore always in one and the same direction the bar is also made magnetic, although there are more effective ways to magnetize iron bars. Iron bars or other shapes of iron will not retain the imparted magnetism for any length of time because of their comparative softness. Steel makes better permanent magnets.

If a long thin bar of steel is magnetized, it will be found that the property imparted to it of attracting iron or other magnetic substances is confined to the ends, or more correctly, to regions near the ends called *poles*. These poles are somewhat indefinite in position, but are close to the ends of the magnet, being distant from each other in a straight bar 0.80 to 0.85 of its length. The line joining the centers of magnetic action is called the *magnetic axis* of the magnet, the distance between the centers is the *magnetic length*.

If two poles are brought near one another, which means the poles of two magnet bars, there will be an action between them, either of attraction or repulsion, according to their similarity or dissimilarity. One end of every magnet is called a "north" pole, corresponding to the pole of a compass needle freely suspended, which points to the north, and the other end the "south" pole. Experience has shown that two north poles or two south poles repel each other, and that a north and a south pole attract each other, whence the rule: *"Like poles repel, unlike poles attract."*

It is assumed that iron or steel in their normal state are composed of extremely small elements of matter; that is, of molecules, representing infinitesimally small magnets which are located in respect to each other without any regularity whatsoever. As soon as a magnetic influence is exerted upon the iron or steel, these molecules are arranged in a certain order so that all like poles of the infinitesimally small magnets point the same way and thus by mutual coöperation act as regular bar magnets do. The influence, which brings about this transformation from non-magnetic to magnetic condition is called *"magnetic induction."*

The magnitude of action between a pair of poles is a measure of the strength of these poles. If two poles are separated a distance of one centimeter and the force acting between them is one dyne, they are "unit poles." Retaining the distance of one centimeter between them, if one of the poles has a strength m, its force of attraction or repulsion is m dynes; if one pole has the strength m_1 and the other pole the strength m_2, the distance between them being still one centimeter, the force is $m_1 m_2$ dynes. The law of action is the following: The force of attraction or repulsion between two magnetic poles varies directly as the product of the pole strength and inversely as the square of the distance separating them. For instance if the distance is reduced to one-half, the force of attraction is increased 2^2 or 4 fold.

If m_1 m_2 be the strength of the poles separated a distance d and k be a constant, then the force of attraction or repulsion is

$$f = k\frac{m_1 m_2}{d^2}$$

This is called Coulomb's law. The constant k is independent of the quantities m_1 m_2 and d; k depends entirely upon the units in which they are measured and the medium in which the action occurs. Assuming air or rather vacuum as the standard medium, and properly selecting units, the constant k becomes unity, whence $f = \frac{m_1 m_2}{d^2}$. If the poles are of equal strength, then $f = \frac{m^2}{d^2} = \left(\frac{m}{d}\right)^2$.

To contribute to the understanding of the relations expressed by the above formula, the discussion of ratios and proportions will be inserted here.

19. Ratio and Proportion

Under ratio is understood the relation which one quantity bears to another of the *same* kind; for instance, the ratio between a dollar and a dime is ten to one, which is written as 10:1. The comparison between two quantities of the same kind is made by considering what part the one quantity is of the other. Ratios are measured by fractions, therefore if we wish to measure the ratio between a dollar and a quarter of a dollar, we must express both in the same units, either in dollars or in cents in this case; taking a cent as the unit we have 1 dollar = 100 cents, 1 quarter = 25 cents, whence the ratio $\frac{100}{25}$ or $\frac{4}{1}$; that is, 4 to 1. If one of two localities has an elevation of 40 feet and the other one of 350 feet, the ratio of their elevation would be 40:350 or 4:35.

A ratio is expressed generally as a:b; the quantities a and b are called the *terms* of the ratio, the first term "a" being the *antecedent* and the second term "b" the *consequent* of the ratio. Expressing the ratio as a fraction we write it $\frac{a}{b}$.

If we have two ratios which are equal to each other, we have what is termed a *proportion*. For instance, if the two quotients $\frac{6}{3}$ and $\frac{8}{4}$ are equal, that is, if $\frac{6}{3} = \frac{8}{4}$, so is this a proportion. This proportion is usually written in the form 6:3 = 8:4 and expressed by saying that 6 is to 3 as 8 is to 4. A proportion in its general terms is writen as a:b = c:d or also $\frac{a}{b} = \frac{c}{d}$. In this connection the terms a and d are called the *extremes*, and the terms b and c the *means*. By multiplying in the equation $\frac{a}{b} = \frac{c}{d}$ both sides by bd, we obtain ad = bc, whence the rule: *If four quantities are in proportion, the product of the extremes equals the product of the means;* conversely: If the product of two of four quantities equals the product of the two other quantities, the four quantities form a proportion of which the factors of one of the products are the extremes and the factors of the other product the means.

From the equation $\frac{a}{b} = \frac{c}{d}$ any of the

*Fifth article on Telephone Mathematics and Physics.

four terms can be found if three terms only are given. For instance if a, c and d are known, then $b = \frac{ad}{c}$. In an equation the unknown quantity whose value is to be determined is usually designated by x; hence the equation is better written as $\frac{a}{x} = \frac{c}{d}$ and solved by multiplying both sides by xd, obtaining $ad = cx$, then dividing both sides by c, obtaining $\frac{ad}{c} = x$.

If the first quantity of a proportion is to the second, as the second is to the third, as the third is to the fourth, and so on, we say the quantities are in "continued" proportion; thus a, b, c, d ..... are in continued proportion when $\frac{a}{b} = \frac{b}{c} = \frac{c}{d} = ...$

If $\frac{a}{b} = \frac{b}{c}$ or $a:b = b:c$ we obtain by multiplication $ac = b^2$; this means b is the "mean" proportional between a and c.

From any given proportion others may be deduced: Take for instance $\frac{a}{b} = \frac{c}{d}$ and add 1 to both sides, thus $\frac{a}{b} + 1 = \frac{c}{d} + 1$, which is the same as $\frac{a+b}{b} = \frac{c+d}{d}$ because $\frac{b}{b} = 1$ and $\frac{d}{d} = 1$. By interchange $\frac{a+b}{c+d} = \frac{b}{d}$ or $(a+b):(c+d) = b:d$ is obtained.

We can also subtract 1 from $\frac{a}{b}$ and $\frac{c}{d}$, obtaining $\frac{a-b}{b} = \frac{c-d}{d}$, whence $\frac{a-b}{c-d} = \frac{b}{d}$ or $(a-b):(c-d) = b:d$. As in the two above cases the right sides of the equation are the same, it results

$(a + b):(c + d) = (a - b):(c - d)$

and also

$(a + b):(a - b) = (c + d):(c - d)$

If three ratios equal each other, for instance, if $\frac{a}{a_1} = \frac{b}{b_1} = \frac{c}{c_1}$ and if each of the three quotients equals n, then we obtain the value of a as na_1; the value of b as nb_1 and the value of c as nc_1; whence $a + b + c = na_1 + nb_1 + nc_1 = n(a_1 + b_1 + c_1)$ and $\frac{a+b+c}{a_1+b_1+c_1} = n = \frac{a}{a_1} = \frac{b}{b_1} = \frac{c}{c_1}$. This shows that, if several ratios equal each other, the ratio of the sum of the antecedents to the sum of the consequents equals either one of the given ratios.

The reader by working out examples will gain a still clearer conception of proportions. We will work out one example and he may follow suit. Let $a = 6$; $b = 3$; $c = 8$ and $d = 4$. Then for $\frac{a}{b} = \frac{c}{d}$ we put $\frac{6}{3} = \frac{8}{4}$ and for $\frac{a}{b} + \frac{c}{d} = 1 = \frac{6+3}{3} = \frac{8+4}{4}$ or $\frac{9}{3} = \frac{12}{4}$, whence $9 \times 4 = 3 \times 12$ or $36 = 36$, which proves the correctness of the formula. By following the same process the rest of the formula can be proven.

Having presented the fundamental conceptions of proportions we now will discuss a few applications in physics. It may be stated that rarely appear in physical formulae proportions in as plain a form as the above deduced general expressions and relations; they usually appear in the form of an equation as will be seen from the example of Cunlomb's law that the force of attraction between two magnet poles having the strength m_1 and m_2 respectively, and being apart a distance d is $f = \frac{m_1 m_2}{d^2}$. If this equation were written in the form of a proportion it would appear as $f:m_1 = m_2:d^2$; but this would not show the meaning of the law nor express the teaching of the formula as well as $f = \frac{m_1 m_2}{d^2}$, which can also be written as $f = m_1 m_2 \times \frac{1}{d^2}$, thus clearly indicating two things, first, that, as f is a function of $m_1 m_2$, the values of f change directly with a change in the values of the product $m_1 m_2$, that is, f is directly proportional to the product $m_1 m_2$, and second, that, as f is also a function of $\frac{1}{d^2}$, the values of f change inversely with the change of values of the square of d, as $\frac{1}{d^2}$ is the reciprocal or inverse of d^2. We could also state the law as follows: The force f is directly proportional to the product $m_1 m_2$ and inversely proportional to the square of d.

As an example of a proportion in its regular form the following will serve: The velocity of motion of a body of the mass M, acted upon by a force K during the time t, is $v = \frac{K}{M}t$, whence $Mv = Kt$. If a force K_1 acts upon the mass M_1 and imparts to it during the same time t the velocity v_1, then $Mv:M_1v_1 = Kt:K_1t = K:K_1$, that is, the forces, which set in motion two masess, are proportional to the movements imparted to the masses in equal time intervals, the movement being the product of mass into velocity.

In the discussion of sound waves it was stated that the intensity of sound depended on the amplitude and number of vibrations per second of the wave. This statement is expressed by the following $I = D(An)^2$, wherein I designates the intensity, D the density of the air, A the amplitude of vibration and n the number of vibrations per second. Taking the density of air as 1, we write the formula as $I = (An)^2$, which indicates that the intensity of vibration is proportional to the square of the product of the amplitude and the number of vibrations per second. This example does not represent a proportion in the sense of the given mathematical definition, but it shows the meaning of the term "proportional" so frequently encountered in the technical literature.

20. Field of Force

A *field of force* is a region in which work is performed in moving bodies in certain directions. Such a field exists about the earth, for between it and all bodies there is an attraction, and work is performed in moving bodies upward from the earth's surface. A magnet is surrounded by a field of force, so is a conductor conveying a current and a dynamo-electric machine. Such fields are imagined marked out by *"lines of force,"* which show by their directions the paths which magnetic poles under their influence would follow if free to move along them. The positive direction of the field is the direction in which an isolated north-pole—if such a pole were a physical possibility—would move, the negative direction being that taken by a south pole.

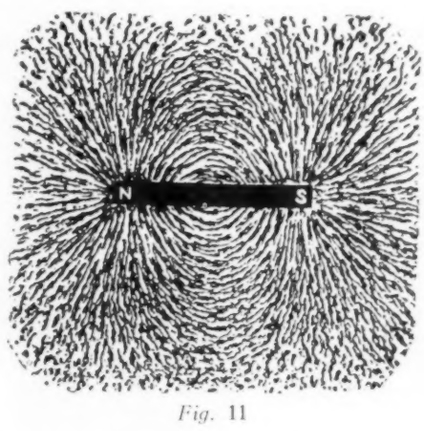


Fig. 11

Although the magnet is magnetized internally—that is, the lines of force are generated and maintained inside the substance of the magnet—the lines may be shown experimentally by laying a smooth sheet of paper over a magnet, sprinkling iron filings on the paper and gently shaking it so that the filings may more easily find their places. The result is shown in Fig. 11. Lines of force are invariably and in all circumstances closed curves.

If a magnetic pole is placed in a field of force or a *magnetic field*, it moves with a force proportional conjointly to the strength of the pole and the strength of the field, a field of unit strength being one which acts on a unit pole with a force of one dyne. Generally the force $F = Hm$, where H represents the strength of the field and m the strength of the pole.

A uniform field is one in which the direction of the force is everywhere the same and the strength equal in all parts of the field, that is, where the lines of force are parallel and equidistant.

A long bar magnet placed with its magnetic axis at right angles to the lines of force of such a uniform field will experience an action tending to turn it parallel to the lines. If H again designates the strength of the field and m that of the poles of the magnet, the north pole will tend in the positive direction with a force of Hm dynes. The south pole will be urged in the opposite direction with an equal force.

A magnet pole may be considered magnetic because of some property imparted to it, perhaps by rubbing it with a piece of magnetic ore or with another magnet. In this sense the magnetism may be regarded as distributed over the polar surfaces with an intensity measured by the magnitude of its action on a unit distribution. The *intensity of magnetization* thus given is the ratio of the magnetic strength to the pole area. As the region surrounding the magnet may be regarded as permeated by lines of force given off by the pole, a convention may be adopted as to the number of lines of force in a unit field, so as to express numerically in lines the strength of any field. A unit field is one in which there is one line of force per square centimeter of area at right angles to the field. The area of the surface of a sphere of radius r is $4\pi r^2$, hence of a sphere of unit radius the area is 4π. There are, therefore, 4π lines proceeding from a unit pole. If the pole has the strength m the number will be $4\pi m$.

Note. "We have shown in an earlier article that the area of a circle is equal to $r^2\pi$. To find the area of a sphere it would be necessary to delve rather deeply into geometry, but there is a simple although only approximately correct way for the reader to prove to himself that the surface of a sphere is $4\pi r^2$ or 4 times the area of a circle. He may cut an orange in two equal halves; then he may cut one of the halves again so as to obtain two quarters. If the peel is taken off of one of the quarters and cut into a number of small squares so that each little square is practically flat and all the small squares and odd pieces are placed close together on the flat circular surface of the half of the orange it will be found that they about cover it, thus showing that one quarter of the area of the entire orange equals the area of its largest circle. Therefore the entire area would be equal to four times the area of the largest circle. If the radius of the largest circle is r, the area of the largest circle would be $r^2\pi$ and the area of the sphere $4r^2\pi$."

The unit intensity of magnetic induction, that is the quantity of induction through one centimeter of surface where the intensity is unity, is called the "Gauss." The unit of quantity is called

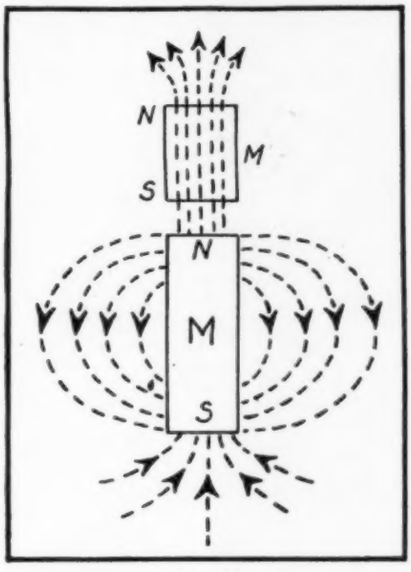


Fig. 12

the "Weber."* At one centimeter from the unit pole the intensity of the induction is therefore one gauss, and the total induction coming from unit pole is 4π webers or 12.566 webers.

In Fig. 12 a permanent magnet M is drawn with only a few lines of force shown. The arrow points show their direction. The north pole is marked N and the south pole S. The smaller bar m opposite the pole N represents a piece of soft iron, which by magnetic induction from the magnet M is made also magnetic, but it remains only as long as it is exposed to the magnetic influence of the magnet M.

If the magnet M in Fig. 12 would be broken into two pieces, two magnets would be obtained, each one having a north and a south pole. On the other hand if two magnets are put together with their unlike poles a single magnet with one south and one north pole is obtained, the poles, of course, being at the ends. Two magnets put together with their like poles give a magnet with two poles of like name at the ends and a common pole at the joint.

21. Permeability

Some substances offer to the propagation of lines of force what may be called a magnetic resistance. The relative capacity possessed by any substance for conducting lines of force is known as its "permeability" and is denoted by the Greek letter μ. The permeability of air or rather the permeability of a vacuum is taken as unity; but as that of air is almost exactly the same as that of a vacuum, the permeability of air is a more convenient standard. The magnetic permeabilities of gases and in fact of all bodies except a few, are very nearly unity also. The two metals used mostly for a magnetic circuit, steel and iron, possess a permeability reaching as high as 2500 or more. A magnetic circuit is a closed circuit consisting of iron or steel.

The permeability of air is constant, but in iron it varies according to the magnitude of the induction. There is, however, a limit to the magnetizability in iron; as the magnetizing force increases, the permeability decreases and the induction, though still increasing, does so at a slower rate, until at last there is very little change in the iron, it is said to have become saturated.

The intensity of the magnetic field is symbolized by the letter H, which signifies also that the magnetizing force produces H magnetic lines per square centimeter in air. In iron the degree of magnetization is symbolized by the letter B. Thus H designates the magnetizing force and B the density of the lines of force in iron or briefly the induction. The ratio of H and B expresses the permeability of the material, thus $M = \frac{B}{H}$.

It is of the utmost importance in the design of electrical apparatus to know the permeability of the different magnetic materials. Some time ago the TELEPHONE ENGINEER brought a description of the loading coils with iron powder cores manufactured by the Western Electric Company, for the long distance lines of the Bell system. Such a core has the advantage of showing a constant permeability and a low hysteresis loss (of hysteresis we will speak presently) at small magnetizing forces, say below 0.1 gauss. It may be stated in general that the limit of magnetization in good wrought iron is about 20,000 lines per square centimeter and in cast iron about 12,000 lines per cm^2, but it is not economical to push the magnetization beyond 16,000 lines in any case for pure soft iron. Pure soft iron has in addition to its high permeability a low retentivity, that is it will soon after magnetization ceases, be deprived of the magnetization effect. This is of importance in many cases of electromagnets, which are required to develop as strong a field as possible at some particular point directly the current commences to flow, and to lose all traces of

*Gauss and Weber were two great physicists.

magnetization on the cessation of the current. Steel, on the other hand, always retains a large proportion of the magnetization imparted to it.

Here may be mentioned that by *"magnetic susceptibility"* is understood the ratio existing between the intensity of magnetization and the strength of the inducing field or the magnetizing force H. The symbol for susceptibility is the Greek letter κ and it is $\mu = 4\pi\kappa + 1$. In paramagnetic substances, that is, in substances possessing the properties ordinarily considered as magnetic, κ is positive and $\mu > 1$. In diamagnetic substances, that is, in substances, which are apparently repelled, when placed between the poles of powerful magnets (zinc, bismuth, phosphorus are diamagnetic) κ is negative, but never large enough to make μ zero.

22. "Hysteresis"

"Hysteresis" designates a retarding effect of magnetization. Professor Ewing, the originator of this name, subjected a soft iron ring to a magnetizing force which he increased to a maximum; then he decreased it down to zero, then reversed it and carried it to a negative maximum and so carried it around an entire circle of magnetic operations. In Fig. 13, the axis of abscissae shows the values of the magnetizing force H marked in positive and negative direction; the values of induction B are marked as the ordinates. He started the magnetization at O. The induction followed the middle curve until it reached the point A, where B = 11000 for H = 7. Then he decreased the magnetizing force and observed the induction, which then followed the left hand curve. When the magnetizing force had reached again zero the induction B still retained a value of 9,000 lines per cm². Then the magnetization was negatived by reversing the direction of the current; when H almost reached the value −2, the induction B was brought down to zero. Then he increased the negative magnetizing force until it had the same value as previously in the positive direction. At the point C the magnetizing force H was decreased again and the right hand curve was obtained. In specimens of steel the loop will be wider and more open. In every case, whether of iron or steel, there will be a loop consisting of a descending and ascending curve. The force H necessary to de-magnetize a piece of iron or steel after it has been magnetized to a given degree has been named *"Coercive Force"* (in Fig. 13 the abscissa from 0 to about +2 or −2). The following table gives some data on coercive force, permeability and remanence. Remanence designates the remaining induction such as indicated in the Fig. 13 by the ordinate from 0 to the descending point 9,000, respectively from 0 to −9,000 on the ascending curve:

Material.	Maximum induction B.	Coercive force.	Maximum permeability.	Remanence.
Cast iron...	10,000	11	200	5,000
Rolled iron.	18,000	0.7	6,000	8,000
Cast steel..	18,200	2.4	2,800	10,000
Hard steel.	18,000	15 to 16	300	11,000

The coercive force depends chiefly upon the nature of the material employed. Dr. Steinmetz found that the loss of energy by hysteresis is due to molecular friction which causes heating

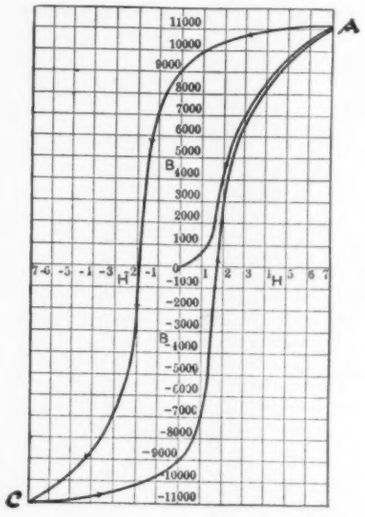


Fig. 13

of the magnet core and can not be overcome by any known means. This heat he determined to be proportional to the 1.6th power of the magnetic induction B, which he expressed by the formula $W_h = \eta B^{1.6}$ wherein

W_h = loss of energy per cycle of magnetization in ergs or C. G. S. units per cm.

B = maximum magnetic induction in lines of force per cm².

η = coefficient of hysteresis. This coefficient varies in iron from 0.00124 to 0.0055. As a fair mean 0.0033 can be accepted for good average annealed sheet iron or steel. In gray cast iron η averages 0.013; it varies from 0.0032 to 0.028 in cast steel according to chemical or physical constitution, and reaches values as high as 0.08 in hardened steel (tungsten and manganese steel).

In soft iron the loss by hysteresis may be reduced by admixture of about 4 per cent silicon.

Permanent magnets lose on strength when subjected to vibrations during the magnetizing process. A permanent magnet brought to a red heat loses its magnetic properties. To give to steel more remanent magnetism chromium cobalt, nickel or tungsten is used as an alloy.

As an example of practical application of the hysteresis loop curve to telephony, a set of curves showing the hysteresis characteristics for annealed uninsulated iron powder cores compressed with a pressure of 203,000 pounds per square inch is presented in Fig. 14. These curves show only one-half of each loop, the other half being identical with the one shown, only it would be reversed. These curves are taken from a paper on "Magnetic Properties of Compressed Powdered Iron" by Speed and Elmen, published in the Transactions of the A. I. E. E. June, 1921.

23. Dimensions of Magnetic Quantities

In the preceding discussion of magnetism nothing was said about the dimensions. For sake of completeness the dimensions will be added here. Previously the dimensions of velocity had been determined as $\frac{C}{S} = CS^{-1}$; the dimensions of acceleration as $\frac{\text{velocity}}{\text{time}} = \frac{CS^{-1}}{S} = CS^{-2}$ and the dimensions of force $= G\frac{C}{S^2} = CGS^{-2}$.

We now deduce the dimensions of the force of attraction or repulsion $f = \frac{m^2}{d^2}$ by putting $\frac{m^2}{d^2} = CGS^{-2}$; multiplying both sides of this equation by d^2 we obtain $m^2 = d^2(CGS^{-2})$ and as the dimension of the distance d is C, we can also write $m^2 = C^2GS^{-2}$, whence the dimension of m, that is, of the *pole strength or intensity* $= \sqrt{C^2GS^{-2}}$ or $C^{3/2}G^{1/2}S^{-1}$.

The dimensions of the *field strength H* are obtained from the equation $H = \frac{f}{m}$ as $\frac{CGS^{-2}}{C^{3/2}G^{1/2}S^{-1}}$ or $C^{-1/2}G^{1/2}S^{-1}$.

The same dimensions hold also good for the *magnetic induction* $B = \mu H$ (found from the formula $\mu = \frac{B}{H}$), as μ is only a numerical factor. The magnetic susceptibility K is also a numerical factor, hence has no dimensions either.

The dimensions are not so much of practical value to the reader as they are educational, the study of their deductions gives a better understanding of the relation of the magnetic phenomena to each other and to the electric phenomena, to be discussed later.

There are a few magnetic phenomena which have not been included in our discussion, but as the reader may come across them in the perusal of books or periodicals, they will be briefly mentioned.

Previously it had been stated that a long bar magnet placed with its magnetic axis at right angles to the lines of force of a uniform field will experience an

action tending to turn it parallel to the lines; the north pole will tend in the positive direction with a force Hm dynes and the south pole in the opposite direction with an equal force. These forces being equal and opposite form a couple, whose moment is Hml, where l is the magnetic length of the magnet. (If forces act upon a body tending to cause a rotation about a fixed axis, then the mass of the body multiplied by the distance of its acting force from the fixed axis is called its moment.) If the field is of unit strength, this moment has the value ml, whence the definition of the

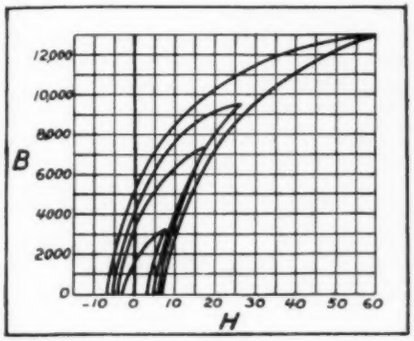


Fig. 14—*Hysteresis Characteristics for Annealed Uninsulated Iron Powder Cores Compressed with a Pressure of 203,000 Lbs. Per Sq. In.*

Moment of a Magnet is the strength of either of the poles multiplied by the distance between them. As the distance is measured in centimeters and the dimensions of pole strength are $C^{3/2}G^{1/2}S^{-1}$, the dimensions of magnetic moment are $C^{5/2}G^{1/2}S^{-1}$.

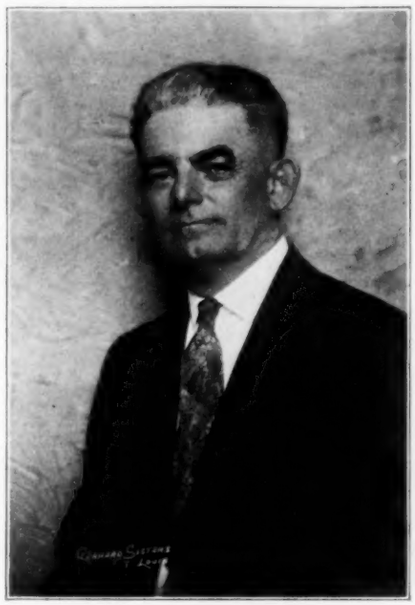
Another phenomenon is the magnetic resistance or the *Reluctance*. Every telephone man knows that electric resistance is the resistance offered by an electric circuit to the flow of current through it. There is a corresponding resistance offered to the flow of magnetizing force in the magnetic circuit. The number of lines of force or the magnetic field Φ corresponds to the electric current and the magnetic flow F to the electric flow. The relation between the magnetic field Φ, the magnetic flow F and the reluctance R can be expressed by the formula $\Phi = \frac{F}{R}$. This formula gives the dimensions of the unit of *Reluctance* as C^{-1}; any resistance being a length.

International Standard Gets Big Italian Job

New York City—The International Standard Electric corporation, the manufacturing organization of the International Telephone and Telegraph corporation, announces that the Societa Italiana Reti Telefoniche Inter-urbane, with which are affiliated the International Standard Electric Corporation, Pirelli & Company, Tedeschi Company, and Siemens & Halske has signed a contract with the Italian government covering the supply and installation of the following network of underground interurban telephone cables: The value of the contract, at the present rate of exchange, is approximately $20,000,000.

Kearney Organizes Line Equipment Company

St. Louis, Mo.—James R. Kearney, a prominent figure in the electrical industry, has organized the James R. Kearney Corporation to manufacture underground and overhead utility equipment. His new plant is located at 4224-32 Clayton avenue, St. Louis, Mo. For many years Mr. Kearney has been associated with the W. N. Matthews Corporation, St. Louis. Prior to joining the W. N. Matthews organization, Mr. Kearney gained practical experience with the Topeka (Kansas) Edison Company. He is regarded as an authority on plant engineering, pole line and underground construction and specialty equipment manufacturing.



In the new Corporation, Mr. Kearney has associated with him a number of prominent engineers and several financial figures. It is the plan of his organization to give to the electrical industry new and improved ideas in utility equipment.

Johnson, Ex-Purchasing Agent, Makes Good on Other Side of Fence

Chicago, Ill.—A. J. Johnson, formerly purchasing agent for Stromberg-Carlson, and for the last two years at the head of A. J. Johnson Co., jobbers, is finding the selling end of business as full of action as he found the buying end. Johnson's business is getting especially good results from his monthly specials. A postcard list of telephone supplies that presents his best pickings is a shopper for his telephone customers.

G. W. Leyda Interests Consolidates and Expands

Deerfield, Wis.—G. W. Leyda, owner of the Deerfield Telephone Co., who recently took over the controlling interest and management of the Brown County Telephone Co., of Denmark, Wis., which has been in the active charge of his son, J. Howard Leyda, has consolidated the two companies under the name of Central Telephone Co., and having purchased the Oostburg Telephone Co. and the Cedar Grove Telephone Co. will operate all companies under the name of the Central Telephone Co., with headquarters at Cedar Grove, Wis. The two properties last named include over 700 subscribers, full metallic, and include a fine modern brick building at Oostburg, in which the exchange and dwelling are located, making a valuable addition to Mr. Leyda's system.

Mr. Leyda will move to Cedar Grove in a few days and will begin making some improvements by way of new cables and rebuilding toll and rural lines.

The exchange at Denmark will continue under the management of his son, Howard, and another son, Donald, will later on take charge of the Oostburg exchange, and work in connection with his father at Cedar Grove, the two towns being but four and one-half miles apart. The Deerfield exchange will be under the local management of H. J. Fadness, who has been employed there for the past four years.

The Central Telephone Co. recently placed on the market a $60,000 15-year 6 per cent gold bond issue, and issued $30,000 in stock. Additional stock will be issued as soon as the company can complete a physical inventory of the system, as it is understood the value of the plants will be in excess of $125,000.

New York Telephone Earnings

New York City—Earnings of New York Telephone Company as shown by its annual report for 1925 were sufficient for dividend payments of $18,001,126 and surplus of $1,023,607. This amount, however, includes approximately $7,000,000 which is subject to possible refund, having been collected for the 10 per cent surcharge in New York City in effect under court order. The report points out that the net earnings on the book cost of the property including allowance for working capital was 4.67% in 1925 against 3.55% in 1924. The company serves about 2,500,000 telephones in New York and northern New Jersey. Nearly 1,400,000 telephones are located in New York City. New construction in 1925 amounted to $74,874,000 while the 1926 program calls for $67,974,000.

Endless Task Is the Good Will Campaign

By E. L. GAINES

Public good will is little different from the good will of a single individual; the good will of a friend. Lasting friendships are seldom made by one kindly act but rather by numerous little thoughtful deeds usually extending over a long period of time and frequently made up of incidents which are merely pleasing trifles, each of which leaves a pleasant memory to cement a true friendship more firmly.

A friendship is broken when one finds a friend has proved himself unworthy, or when one believes a friend has so proven himself. It is hard to gain true friends, but very much more difficult to regain a friendship when once it is lost. The hardest task of all, and the most worthwhile, is to gain the friendship of one who has been an enemy.

The business of gaining and holding public good will for a firm or corporation is very much like making and holding personal friendships, in principle at least. Good will is founded first on service, then on fairness and courtesy. Just as one likes to have a friend whom he can trust, so the public wants to deal with a firm or corporation that can be trusted, that will deal fairly and squarely and that will render service with courtesy.

One Error Ruins All

Years of patient service may be required to gain the public's good will; years of fair dealing and courteous treatment. Then all may be lost in one single mistaken move that may be unethical or ill advised, or, as is more likely to occur, that is fair and square but is misunderstood by the public because it was not properly informed.

The friendship of close, true friends is usually retained through the most trying difficulties because they know all of the extenuating circumstances and understand the situation. The friendship of others is lost because of their knowledge of a half truth. The good will of the public is no more fickle than the friendship of a good friend. It is more difficult, however, to keep the public informed of one's problems and the reasons for all actions affecting the public and because of that difficulty ample publicity is sometimes neglected and as a result much public confidence and good will is lost. This is especially true regarding public utilities.

The public utility is most peculiarly situated as regards public relations. It is unlike the merchant who caters to a comparatively small group of customers in the community within which he operates his business. In that same community other merchants compete with him and each one sets standards with which all must comply if they are to receive their portion of the community's business. These standards may be high or low as the case may happen to be, but the public knows what the standard is and usually accepts it without complaint so long as they have the privilege of changing to another merchant if they are not satisfied with the treatment received.

In most cases the public utility has a monopoly of the business in which it is engaged in so far as that community is concerned and the public whom it serves becomes more critical of the service standards maintained. The merchant naturally draws to his place of business his personal friends and those who like his particular customs and methods of doing business. Those who are not attracted by his methods seek stores more in keeping with their individual ideas of things. The public utility, however, must serve every one. Not only one small community but an entire city, county or district, as the case may be. It must serve all kinds and classes of people and the people as a rule have no other choice and as individuals are comparatively helpless in the matter if the service is not satisfactory.

Regardless of the quality of service rendered by a public utility having a monopoly in a community, an uninformed public will set up unreasonable service standards and will be inclined to feel that it has a just grievance against the utility if these standards are not maintained. An uninformed public dealing with a monopolistic company will also be inclined to resent the most reasonable rates, firmly believing it is being charged profiteering prices for service when in reality the utility may be entitled to a larger return on its property.

If there were a dozen public utilities selling the same kind of service in the same community the customer would pay that same rate without thought of its being excessive and with no criticism of its quality. His reason would convince him that competition would keep prices and service right.

This brings out the fact that the public utility operating a monoply in a community must exert greater effort to obtain and hold the good will of the public than does the merchant operating a competitive business. It is neither necessary nor desirable that the public know the merchant's selling costs or profits. He is entitled to make what he can so long as he does it fairly. But the public utility has been granted an exclusive right to sell service in a community, under reasonable restrictions, and in return the public is entitled to know not only the selling costs and earnings but the detail of the company's affairs.

The public is entitled to this information and it is to the best interests of the public utility to see that the public gets it and understands it. The public has confidence in things it understands and is one of the fairest of judges, when fully informed.

"Keep Everlastingly at It"

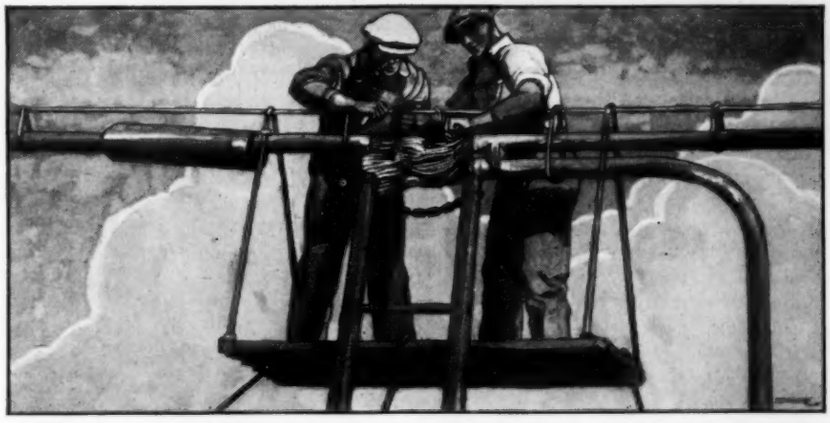
To a certain extent then, the public utility's problem of maintaining proper public relations resolves itself into a continuous educational campaign. The public must be told, then told again, and the same thing must be repeated year in and year out. The public never becomes educated, as is proven by our public school system. The work must go on year after year and generation after generation and although the task is endless, it is well worth while.

The educational part of public relations is important, but after all it is only one of the many things necessary to maintain good will.

From the time the customer first applies for service until his final bill is paid each and every contact between the utility employe and the customers, as well as each and every bit of service rendered, goes to make up either good or bad public relations. Service itself, while vital to good will, will not produce good will without proper employe contact and courteous treatment of the customer. Efficiency on the part of the utility employe is also productive of good will towards the company, for next to courtesy, efficiency is expected and required by the public.

In the case of a telephone company a prospective customer applies at the contract desk for telephone service. If he is met pleasantly, but not effusively, and his wants courteously cared for in a bus-

Joining the wires in a great trunk nerve between New York and Chicago



The Nerves of a Nation

THE magnitude of our present system of telephone communication was beyond the thoughts of men fifty years ago. While at that time Bell, the inventor, had a prophetic vision of places and houses and factories connected by telephone, even he could not have foreseen the American city of skyscrapers with more telephones in one building than are to be found in many a foreign country.

The massed multitudes of the modern city can no longer be served by wires strung in the air. We now have telephone cables no bigger than a man's wrist, each containing 2400 thread-like wires, carrying beneath the city streets their millions of spoken messages. Long distance cables overhead and underground connect cities with one another by storm-proof conductors, now being extended into a country-wide network.

At the present time nine-tenths of the 45,000,000 miles of telephone wire in the Bell System are in cable. The service of each telephone user has become more and more reliable with the extension of this cable construction.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

BELL SYSTEM

IN ITS SEMI-CENTENNIAL YEAR THE BELL SYSTEM LOOKS FORWARD TO CONTINUED PROGRESS IN TELEPHONE COMMUNICATION

inesslike manner, an excellent start has been made towards gaining a friend and booster for the telephone company. And it is at the contract desk that customer education should begin. Doubtless he is more or less unfamiliar with the general regulations and practices of the company. He is in a receptive mood and wants to learn. Tell him the things he needs most to know and explain why such practices and regulations are necessary. A few minutes in properly selling a customer in the beginning are worth hours of explanations later on.

The men who install the telephones have a no less important part to play as good will builders than the employe at the contract desk. When the wires are arranged for the telephone the workman may make a nuisance of himself to the housewife by tracking over the floors with dirty shoes and leaving bits of insulation and plastering lying about. Loud conversation and laughter are equally annoying in some cases. A clean, quiet workman who completes his task with neatness and dispatch is an asset to any telephone company.

After the telephone is installed and tested, a little diplomacy is usually needed on the part of the installer to determine just what instruction may be needed by the new subscriber. Some people do not like to receive instruction and mildly resent it even though given in the kindliest manner. This is probably due to a fear on their part that they may appear ignorant. Usually it is possible for an installer to engage the new subscriber in conversation regarding the installation or the service and tactfully bring out the essential points necessary for his education. An installation should never be regarded as complete until it satisfies the subscriber in every respect.

So far our good will building has been preliminary to the rendering of service. We have simply been laying a foundation for a good will structure to be gradually and carefully erected, little at a time, through months and even years of serving. And at every contact with the subscriber during all that time good public relations are being built or torn down.

Every call over the line adds to or subtracts from the subscriber's store of good will towards the company according to the quality of the service received. The promptness and courtesy with which trouble is cleared and the degree of dependability and continuity of the service are also important factors in public relations. The quality of transmission and even the appearance of the telephone instrument itself located on the premises of the subscriber each adds or subtracts its share.

The association of the company with the subscriber is very close; in fact, the telephone itself is the company's representative in the subscriber's home at all times, and if the association is largely of a pleasant nature a strong and lasting friendship will gradually develop; a mutual friendship which may not easily be broken.

It has been facetiously said that in America friendship does not extend to the pocketbook. Regardless of the amount of truth in this statement, the idea it contains will bear consideration when dealing with customers. When the monthly statement for service is mailed to the subscriber a contact is made with a most sensitive spot and all of the diplomacy, tact and courtesy at the command of the company should be employed by the collection department. It is not necessary nor advisable for a company to be afraid to ask for the money justly due it for service, nor should it fear to make its demands firm and strong when occasion requires.

All subscribers are entitled to be considered "good pay" until proved otherwise and must be given the utmost consideration and courtesy in the matter of collections. Above all else, statements of accounts should be correct. Perhaps no act on the part of a public utility is so productive of distrust as accounting errors. Banks and trust companies learned the lesson of accuracy long ago and all public utilities must learn it if they expect to retain the good will of their customers.

A great aid towards the maintaining of good public relations by a utility of considerable size is a complaint department so organized that all chronic complants are eliminated. A good follow-up system in the complaint department makes this a comparatively simple matter and makes a host of friends for the company.

During the past few years long strides have been made towards solving much of the public relations problem in public utility management by employe and customer ownership. This gets back to the idea contained in the pocketbook remark; the employe and the subscriber become partners in the business and having common financial interests, they begin to look at the affairs of the utility in a different light. This is not to the discredit of the new stockholder, but rather to his credit. The financial interest is about the only interest that can be a common interest to all kinds and classes of people and its use in this respect by the utilities is highly laudable. It makes boosters of many who would otherwise be disinterested and offers the utility splendid opportunities for the distribution of information for subscriber education.

The means that may be used for subscriber education are many, but it is not always an easy matter to determine which is most effective for a given case, or which should be used and which left unused. Among the means that may be employed might be mentioned the following:

Paid newspaper advertising.

Newspaper publicity stories.

Telephone directory advertising and instructions.

Direct mail advertising; letters, circulars, etc., or inserts with bills.

Billboard advertising.

Show window advertising.

Street car card advertising.

Movie film advertising.

Novelty advertising.

Lectures and demonstrations.

Employes' magazine (mailed to all employes and subscribers).

Word of mouth advertising, or employe and stockholder boosting.

Kind Words' Cash Value

It is a truism that the most powerful form of advertising is word-of-mouth. Printed advertising would be unnecessary if employes and stockholders consistently boosted for their company. If subscribers would talk as much about the good service they receive as about the occasional service error the printing press would not be needed to help create good will. But people tire of talking of one subject and do not always tell the truth.

Above all else advertising must be truthful. It must be consistent, persistent, and insistent. It must cover all important points and must be changed as conditions change. Facts must be told over and over again, as the public's memory is short. One of the best results of printed advertising is the stimulating of word-of-mouth advertising.

The local newspaper may be either the best friend or worst enemy of a public utility. A reasonable amount of paid advertising carried regularly in local newspapers will be productive of more good will than can be gained in any other way with an equal expenditure of money. All utilities should advertise regularly in their local papers, using only carefully prepared copy and changing it often. The space used need not necessarily be large and the frequency of the appearance depends upon local conditions.

It is not necessary, in fact, seldom possible, to buy the good will of local newspapers. A regular advertising account will help keep them in a good frame of mind, however, and may be the means of getting good news story space when wanted. And just a word about news stories. A newspaper should never be asked to carry a story as a news article unless it has real news value. If the story is worth reading the paper will gladly print it. If it is news the newspaper wants it because that is its busi-

The Everhot
No. 50 Blow Torch

In All Weather—

The EVERHOT No. 50 Blow Torch

In driving rain or blinding snow the **Everhot** No. 50 Blow Torch works steadily on, a worthy companion for the hardy linemen who keep communication lines open, regardless of weather.

Protected by its metal windshield, the flame burns steadily under all conditions.

Special features which stamp the **Everhot** No. 50 as a blow torch of sterling quality are:

16 gauge copper tank
Guaranteed long-life burner
Non-enlarging orifice
Reinforced pump stand
(Connection will not strain)
Wind shield

The **Everhot** No. 50 Blow Torch is unrivaled for its ability to generate quickly and for its dependability in those emergencies which tax both men and equipment alike.

EVERHOT
America's Brand Makers
MANUFACTURING CO. MAYWOOD, ILLINOIS

The PEIRCE TELEPHONE WIREHOLDER

ALL-PORCELAIN TYPE

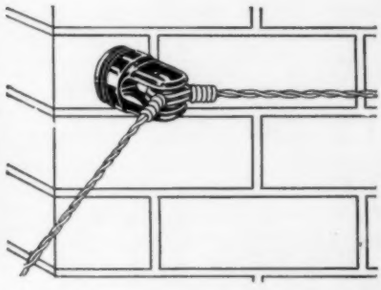
The Peirce Telephone Wireholder is a modification of the No. 1621 Peirce Wireholder which is very popular with Central Stations for making house service connections.

This type of Telephone Bracket has been designed so that no metal is exposed after installation. It is not affected by atmospheric conditions and will not make rust stains on your house.

The wire hole groove is 9/16 x 3/4-inch and the double groove on the top makes an ideal arrangement for tying twisted telephone pairs. The No. 1622 Wireholder is used as a corner Bracket where the lead from the pole comes to the building at an angle and as a standard house Bracket for carrying the pairs on a straight run along the building or for dead-ending.

It combines a wall bracket, insulator and screw all in one. To install: a jab—a few turns and it is in. Safe for 1000 pounds strain.

No. 1622



An installation of No. 1622 Telephone Wireholder used as a corner Bracket in a brick wall. Note the neat tie of the twisted pairs that can be made with this type of Bracket.

Hubbard and COMPANY
PITTSBURGH • OAKLAND, CAL. • CHICAGO

ness. The amount of space and the position given may vary directly with the attitude of the paper towards the utility, however, and this is where the newspaper's good will comes in. Utility men should cultivate the friendship of newspaper proprietors, editors and reporters.

It is usually best to allow a reporter to write his own story. If he asks for a story to be written up, do it; otherwise let him write it himself. That is his line of work and he usually likes his own writing best. Make sure that he has the facts and understands the utility's side of the story. Remember that if you are on the good side of the newspapers it is next to impossible for politicians to make a football of your property. Give the newspaper every bit of news relative to your company. It wants it and and the public wants to read it. If the public is kept informed of what you are doing and what you are trying to do your problems will be much easier of solution.

Ordinary courtesy requires that the public be informed in advance of any changes affecting the service in any way.

Directory advertising may be used to advantage by all telephone companies and a directory should never be issued without carrying a reasonable amount of company space. Rules and instructions should be clear and easily understood and not too voluminous. The directory is an excellent means for advertising extension telephone service and any special service the company may be selling.

Direct by mail advertising may be used at times. The cost of individual mailings usually makes this form prohibitive for telephone companies excepting in the case of securities sales. Circulars must be very attractive to get attention. Inserts with the subscriber's statement for service may be made once or twice a year. If sent oftener they may be considered a nuisance and seldom read. One of the fundamentals of good advertising is to make a pleasing impression or to make an impression while the subscriber is in a pleasant frame of mind. The monthly statement is not the most pleasing thing and its use to convey advertising matter is problematical.

Bill board advertising has been little used by telephone companies. There seems to be no reason why they should not make use of it with advantage if others do. It must be remembered, however, that billboards are distasteful to some people who regard the advertisement as an affront to good taste. It is claimed that billboards disfigure the landscape; they also beautify and cover up many ugly dumpheaps and piles of junk. If a billboard is used its location should be the subject of careful consideration.

Show window advertising may be used to great advantage where a good window is available. Displays should be changed frequently and should be of a timely nature. The window should always be neat and attractive.

Street car card advertising, movie film advertising and novelty advertising may all be used to advantage at times. It should be remembered when giving away novelty advertising that a good friend cannot be purchased. If the gift is of but little value it will probably be thrown away. There is some question as to the ethics of giving away gifts or souvenirs of value for advertising purposes.

Lectures and demonstrations, mentioned in the foregoing list, are usually used to educate the public regarding radical changes to be made in the service or equipment. They are exceedingly valuable at such times.

The use of employes' magazines for building better employe relations is not new, but the recent practice of some utilities of mailing the employes' magazine to all customers is a comparatively new departure in public relations work which promises excellent results. An attractive employes' magazine or house organ will be very generally read by the general public and offers an unusually good means of keeping it informed regarding all matters pertaining to the utility. Some companies are now mailing out more than 125,000 copies of employes' magazines to customers each month and are enthusiastic about the results obtained.

The foregoing résumé shows there are ample means to convey information to the public to keep it well informed at all times as to the activities of a utility, and if such means are intelligently used one needs have no fear as to the results. This is taking for granted that the utility is acting in good faith and is exerting its best efforts to render good service. No set rule can be given which may be followed in all cases to determine just how much money should be spent for advertising and the proportion of the total to be used for any particular means.

Newspaper advertising as a general rule should take at least half of the advertising appropriation, the remainder to be divided among other forms as may seem advisable at the time.

The amount that should be set out in the budget for publicity and advertising purposes will vary from year to year as local problems require. A recent survey of twenty-five large public utilities, including gas, electric light and power, street railway and interurban, water and telephone companies, shows that the average utility in the group spends four mills of each dollar of gross income for advertising purposes. None of these utilities spent less than three mills and none more than five. This does not include the cost of selling securities, which is regarded as sales cost and charged against the securities sold.

In recent years public service commissions have looked favorably upon a judicious use of advertising by utilities under their supervision, recognizing the need for its use to build and maintain good will for the utility and at the same time no doubt realizing that their own task of regulating is made much easier when the public and the utility are on friendly terms.

Hosea Buys Logansport (Ind.)—Uhl Still Manager

Logansport, Ind.—Indiana Telephone Securities Company, headed by Max Hosea and officials of the Fletcher American Company of Indianapolis, has bought the Logansport Home Telephone Company at a reported cost of $800,000. Walter J. Uhl, manager of the local company since its organization, 25 years ago, remains as manager. More than 20 Indiana Independent companies now are under Hosea management.

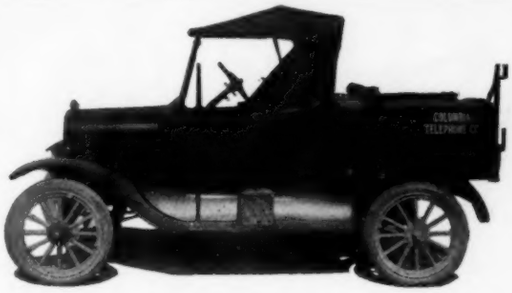
The Logansport company has been one of the liveliest, well managed companies in the Hoosier empire and it forms a big addition to the Hosea holdings. The new directorate will include Indianapolis and Logansport men, so the voice of the community will continue to have strength in operations under the new regime.

L. W. Conrow Goes With Graybar Public Address Dept.

New York City—Announcement is made by the Graybar Electric Company of the appointment of L. W. Conrow to public address department.

CEDAR POLES
NORTHERN ⁘ WESTERN
BUTT-TREATING - GUARANTEED GRADES
ANY SPECIFICATIONS REQUIRED
BELL LUMBER CO., Minneapolis, Minn.

Any telephone book printed may be purchased from the
BOOK DEPARTMENT of
TELEPHONE ENGINEER
28 East Jackson Boulevard CHICAGO



Type SC-172

Cabinet Body for Ford Roadster

A STRONG, light-weight, convenient cabinet body used in connection with the standard Ford roadster. Soon repays its first cost. Standard equipment with some of the largest telephone and power companies. Equipment includes ladder irons and rear fenders.

Write for Bulletin No. 214 giving prices and full information

HOOVER BODY CO.

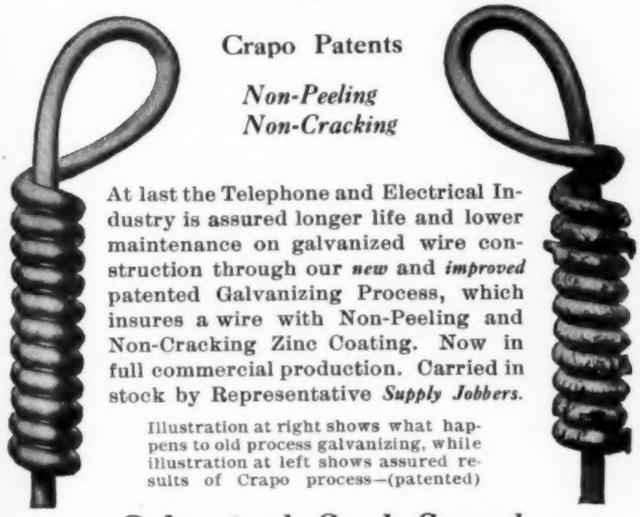
YORK, PENNSYLVANIA

"INDIANA"

Double Galvanized Telephone and Telegraph Wire

Crapo Patents

Non-Peeling
Non-Cracking



At last the Telephone and Electrical Industry is assured longer life and lower maintenance on galvanized wire construction through our ***new*** and ***improved*** patented Galvanizing Process, which insures a wire with Non-Peeling and Non-Cracking Zinc Coating. Now in full commercial production. Carried in stock by Representative ***Supply Jobbers.***

Illustration at right shows what happens to old process galvanizing, while illustration at left shows assured results of Crapo process—(patented)

Galvanized Steel Strand

Standard or Commercial, Siemens-Martin, High Strength and Extra High Strength Grades

Indiana Steel & Wire Co., Muncie, Ind.

KESTER SOLDER

Rosin Core

In the telephone field Kester Solder is the standard for both maintenance and production work. The comprehensive line of Kester Solder embraces a range of sizes from approximately 1/4″ to 1/16″ in diameter. Standard Acid Core diameter, being 1/8″ and standard Rosin Core diameter 3/32″. Packed on one, five, ten and twenty pound spools, there is a range of size and style of package suitable for every practical purpose.

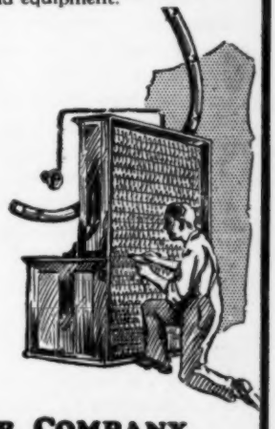
For heavier electrical work Kester Acid Core Solder can be used with considerable saving in time, labor and material.

For the more delicate electrical work on switchboards, etc., only Kester Rosin Core Solder should be used. Its pure rosin flux eliminates every danger of corroded work.

Most telephone companies specify Kester Rosin Core Solder No. 2, 50 core for line splicing as it not only conforms with the standard specifications, but also speeds up this class of work.

Kester Solder either rosin or acid core is handled practically everywhere by jobbers of telephone supplies and equipment.

We maintain a completely equipped research laboratory where we have solved soldering problems for many manufacturers. While our standard line of Kester Solder is adequate for practically every soldering job there are occasions where a specially developed solder and flux are required.



Consult our Research Engineer on your soldering problems

CHICAGO SOLDER COMPANY

4218 Wrightwood Avenue Chicago, Ill.

Originators and world's largest manufacturers of Self Fluxing Solder

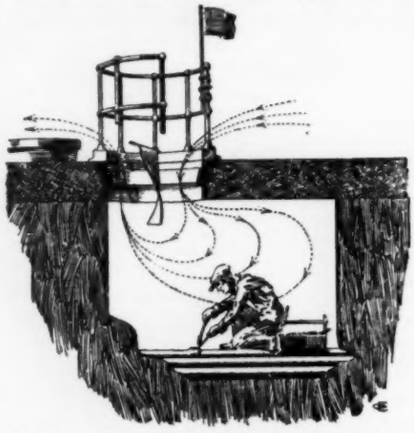
LINE AND DESK

NOXIOUS GAS

Gas often encountered in manholes will make workmen sick, dizzy and listless, most always to be in company with a headache and a great desire to sleep. If you have any of the above symptoms when in a manhole get out into the fresh air at once. Do not delay, never attribute symptoms to indigestion—you are in danger of losing your life!

Carbon monoxide is present in practically all forms of gas. It is a treacherous gas, *deadly, colorless and odorless.*

When a person inhales gas it envelopes the lungs and seals them, thus preventing fresh air from being assimilated, meanwhile the carbon monoxide chemically combines with the blood in such a manner as to remove all the oxygen in the



blood. Thus with fresh oxygen being denied, and that which is still thriving in the veins being systematically destroyed, means that within the space of a few minutes death is practically inevitable. One cannot live without oxygen.

A very simple method of ridding manholes of noxious gasses is shown in the illustration. A good size piece of rubber, canvas or the like is hung in the mouth of the hole so that a current of air is set up. The fresh air comes in one side of the strip and the bad air and gasses go out on the other side as indicated by the arrows.

Always take this precaution, and never fail to have someone within calling distance as the gasses in the manhole may be so strong as to pollute the good air and nullify its good. Remember, take no chances, carbon monoxide kills in a few minutes.—Cincinnati Telephone Bulletin.

NO USE FOR THE HANDAXE

I have been reading many safety hints that you have been printing in your Line and Desk department but I have never seen anything about the use of the handaxe. Just why the handaxe should be one of the regular tools on most line jobs is something I have not been able to figure. I have been on a job for three years and during that time there has not been a handaxe on the job. Neither the company nor any of the men even own a handaxe. We carry a regular chopping axe for chopping work on the ground. Above ground we use saws for trimming, etc. For driving heel bolts, guy hook lags and other driving jobs, a 2-pound machinist's hammer beats a handaxe in every way. Many men have been hurt by the sharp edge of a handaxe and my idea is that no tools should have sharp edges unless the edge must be used in the work that the tool is doing. About the only edged tool that gets off the ground on our job is the framing chisel. If anybody has anything good to say about the handaxe as a lineman's tool, let him say it and I will argue it out with him till the cows come home.—Contributed by Bob Ewbank.

"SHORT OUT THE RINGERS"

From Red Wing, Minn., comes the following:

During a recent cut-over in a small exchange there was a shortage of installers. In order to get the job done in the required time, it was necessary to assign a couple of linemen to this task.

One old lineman who had been "hitting the sticks" for the last twenty years was put to work installing a telephone and it happened that the instrument he was working on had an open ringer circuit. In testing it out with the tester, the man at the desk was trying to help the old fellow locate his trouble.

"Short out the ringers," said the tester. No results.

"Are you sure that you've got a short across the ringers?"

"Positive," said the old fellow.

Just at this point of the conversation the foreman stepped in. Imagine his surprise when he saw the old fellow standing there arguing with the tester and holding his screw-driver across the bells! —Northwestern Bell.

AN UNUSUAL CASE OF UNDERGROUND TROUBLE

Birmingham, Ala., recently experienced one of the most unusual cable troubles in the history of the telephone business, says Harry Singler in "Southern Telephone News."

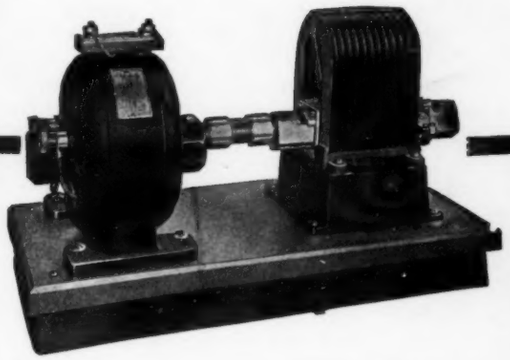
The Birmingham wire chief reported that a 400 pair underground cable had "gone down," bridge measurements showing the trouble to be at the intersection of First avenue and 20th street, the heart of the business section of the city. Everything was made ready and Foreman "Tobe" Smith ordered the old piece of cable pulled from the duct. Just about this time, however, cable No. 1, a 600 pair underground cable feeding the business section, "went down."

At the point where the trouble was located the telephone company has two runs of cable, one through creosoted ducts and the other through tile ducts. The construction forces having already rodded a spare duct in the tile run, Plant Superintendent Mercer ordered the spare duct in the creosote run to be rodded. The men went about this work with a will, but finally, after pushing rod after rod into the creosoted duct, wondered why the rods did not come out in the next manhole.

Sensing something out of the ordinary, Mr. Mercer ordered the rods withdrawn and the mystery was solved, for in a short while the end of a burned rod appeared. Upon the discovery there was a fire under the street, Mr. Mercer ordered the street opened. As the digging proceeded and the dirt was penetrated there was a burst of smoke and flame, necessitating a call upon the city fire department to extinguish the fire.

The fire put out, digging was resumed, but before the duct line was reached a steam pipe, encased in creosoted boards and badly burned, was struck. When the conduit was reached a section of six duct single creosoted conduit, carrying four cables, was found to have been on fire with a section of approximately 6 feet of both duct and cables entirely burned away. A stack of twelve multiple clay duct, carrying several cables, lay adjacent to the creosoted duct and remained apparently undamaged. Examination revealed that one cable in the clay duct, the cable nearest the creosoted duct,

(*Continued on page* 42)



Holtzer-Cabot

MAGNETO—RINGING—MOTOR—GENERATOR

Do Away with Batteries

Wipe out the constant attention and replacement costs required to render ring service.

Install a **Holtzer-Cabot** Magneto-Ringing Motor Generator which does its work under all conditions without variation.

It never fails—gives constant service at a lower cost than any other ringing method.

The Holtzer-Cabot Electric Co.

125 Amory St., Boston, Mass.

6161 So. State St., Chicago, Ill.

BRACH VACUUM ARRESTERS

at prices within your reach

When the best protection costs no more, why not have it? BRACH arresters insure; non-grounding of lines, cables, clear transmission, balance of potential between pairs, and full protection against power crosses or lightning. There are no carbons to clean and no maintenance bills.

You can readily afford BRACH Vacuum Arresters at our present low prices. Type 440, showr above, is furnished with porcelain base, fuses and mountings.

L. S. BRACH MFG. CO.
NEWARK, N. J.

Get EVER-PROTECT aid in your construction.

EVER-PROTECT has proved practical and profitable in making many hundreds of cable installations underground without a conduit. It protects cable against storm damage, corrosion, chemical action, electrolysis and abrasion.

In liquid form EVER-PROTECT is great for overhead work, protecting your cable and messengers against chemical action and other destructive influences.

Ask your nearest jobber for complete details.

National Cable Compound Co.
Incorporated
MITCHELL - - IND.

UNIVERSAL CYLINDER BELLOWS

keep the switchboards and other telephone apparatus free from dust and dirt. One stroke produces a powerful current of compressed air that removes all dust and dirt beyond the reach of a rag. Carried in stock by dealers in telephone supplies, or write direct for literature and prices.

P. PEIFFER
80 LIBERTY STREET
NEWARK, N. J.

"REBUILT" TELEPHONE APPARATUS and exchange equipment saves you 30 to 50 per cent without sacrificing quality or efficiency.

SWITCHBOARDS—Telephones—Apparatus—Protection Equipment—Cable—Everything you need for the installation and operation of a complete exchange—Magneto or Central Energy—of the best and most reputable manufacturers.

Fourteen years' successful operation of our rebuilt equipment department puts it past the experimental stage. Quality and price will make you a permanent customer. Better investigate.

BARGAIN BULLETIN NO. 78 FREE

Address "REBUILT" EQUIPMENT DEPARTMENT

Premier Electric Company 1800-4 Grace St. Chicago, Ill.

For Maximum Service—Baker Contact Points

DEPENDABILITY and long life are the two essentials in a contact point. This "heart of the machine" should function evenly and steadily over long periods of time—it should not need replacement at frequent intervals.

Baker Contact Points are made with this principle always in mind and the name "Baker" assures that perfect performance, without constant renewal, which is the outstanding characteristic of a *good* contact point. Our contacts are made of Platinum, Iridio-Platinum, Silver and Special Alloys. There are sizes and types for all purposes.

BAKER & CO., INC.
54 Austin St., Newark, N. J.
NEW YORK CHICAGO

was damaged from the heat melting away the armor.

The steam pipe encountered crossed over our duct with a separation of about fourteen inches and, as stated, the casing about this pipe was badly burned. While the cause of this unusual fire has not been determined definitely, it is considered possible that the intense and constant heat from the steam pipe had so dried out the creosoted ducts in the immediate vicinity as to render them susceptible to ignition. Whether the steam pipe caused combustion to set up in its casing or whether some electrical condition ignited the duct is a matter of surmise. Investigation of the matter is being continued and it is hoped the cause will be definitely determined.

A survey of the damage showed that five underground cables were burned to a crisp in sections running from six to twenty feet. All plant was permanently restored and placed in service in 65 hours at a cost of approximately $6,000.

CARRIER SYSTEM FOR AUSTRALIA

The International Standard Electric Corporation, formerly the International Western Electric Company, Inc., has received an order by cable through its associated Australian company from the Australian Government for a single channel carrier telephone system. The equipment called for will provide an additional channel for long distance telephone communication over existing wire lines by means of "carrier" currents higher in frequency than speech currents.

In addition, carrier current equipment furnished by International Standard has just been cut into service by the Postmaster General's Department between the important cities of Sydney and West Maitland. The equipment not only provides six additional telephone channels over existing wire lines but also makes possible important improvements in the quality of the telephone transmission between widely separated cities. Thus by connecting the new circuits to existing International Standard type carrier circuits between Sydney and Melbourne and to ordinary overhead telephone lines between West Maitland and Brisbane, high grade telephone transmission may be obtained between Melbourne, the capital of Victoria, and Brisbane, the capital of Queensland, a distance of 1239 miles.

Carrier systems are especially well adapted to conditions in Australia. Where important centers are separated by great distances and telephone facilities become inadequate due to growth in traffic, the number of channels for the transmission of speech is being increased by their use without the necessity of stringing additional wire circuits. In this way very considerable savings in the first cost of telephone plant are being realized.

AN INTERESTING TELEPHONE SIGN

While bouncing over the roads of southern Luzon in a car of the type that made Detroit famous, in the barrio of San Pablo, 88 kilometers from Manila, I chanced upon a well-painted sign

tacked to a palm tree that advised the world the location of the Telephone central. The office was located in the Presidencia which corresponds to the city hall in the states. The church in the background was built by the Spanish and is probably one hundred and fifty or two hundred years old. The two flagstaffs are to accommodate the Stars and Stripes on the right and the Filipino flag on the left. The day the picture was taken was rainy, so neither flag was up.

Runzel-Lenz Cords plug a profit leak

Loss of profit from cord troubles at the board and instruments often is considered a necessary evil by many telephone men. You don't know how greatly you can cut this expense until you standardize Runzel-Lenz switchboard and telephone cords.

For more than a quarter of a century Runzel-Lenz has specialized in cord making. Our laboratories are constantly testing, and continuous research work in the field is being conducted by us, so every possible detail of betterment in cords will be found in Runzel-Lenz cords first.

You are well ahead of the game when you put in Runzel-Lenz cords and watch their performance carefully. You are bound to see a plain case of Runzel-Lenz superiority every time you make a competitive cord test.

RUNZEL-LENZ ELECTRIC MFG. CO.

1751 North Western Avenue
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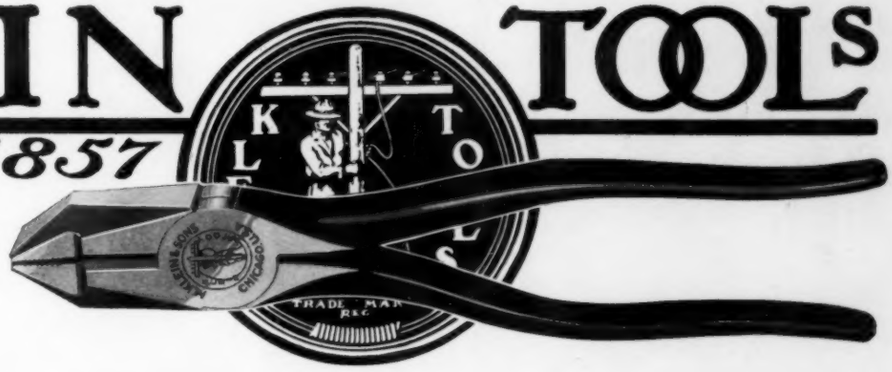
Since 1857



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Established 1857 Chicago Ill USA

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Fir—Yellow Pine
Plain or Treated
LOCUST PINS, OAK BRACKETS, ETC.
All cross arms manufactured and shipped from Baltimore, Md.
GULF CROSS ARM CO.,
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Telephone Engineers
Specialists in Appraisals, Rate Surveys, Financial Investigations, Organization and Operation of Telephone Companies.
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Keeps the records and makes up all reports for companies (large and small) in 17 states. The cost is about half the salary of a bookkeeper. It will not cost you anything to inquire as to our plan, charges, etc. Write today.
CoffeySystem & Audit Co., Indianapolis, In .

SCRAP PLATINUM
Highest prices paid for discarded or obsolete telephone and switchboard apparatus; platinum contact relays, ring keys, etc. Have specialized in this field for many years.
CONTACT METALS CO.
221 E. 23rd St., Chicago

Send for free sample and prices on
UNIVERSAL DROP WIRE INSULATORS
Universal Specialty Company
120-A, S. 7th St., Terre Haute, Ind.

TELEPHONE EQUIPMENT

Western Electric 1020-AL common battery desk sets with steel bell boxes	$10.00
W. E. No. 46 and No. 20 induction coils	.50
W. E. 1-MF condensers...	.35
W. E. 2-MF condensers..	.50
W. E. No. 110 and No. 47 switchboard plugs, 35c and 25c	

BUCKEYE TELEPHONE & SUPPLY CO.
COLUMBUS, OHIO

Get your
Telephone Repair Work
done at the old reliable
Telephone Repair Shop
SUTTLE EQUIPMENT CO.
LAWRENCEVILLE, ILL.

WANTED
Like to buy telephone exchange, from four to five hundred stations.
HENRY ZEITNER
Tripp, So. Dak.

New York City—Directors of the New York Telephone company have recently authorized the additional expenditure of $15,747,610 for new construction in various parts of the territory served by the company. This brings the total appropriations made since the first of the year to $49,652,978.

CEDAR POLES

Quick Delivery
Prices and Quality Satisfactory
"Producer Direct to Consumer"
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Seguin Bldg., 421 St. Paul St.
QUEBEC CITY, P. Q., CAN.

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Specialization on Public Utility Accounting Records and Audits enables us to best serve Telephone Companies.
HERDRICH AND BOGGS
Certified Public Accountants
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J. K. Johnston, Telephone Engineer
During recent years I have been privileged to appraise Telephone Exchanges all over the United States. The list totals 520. Would you like to avail yourself of my services?
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Specializing in Overhauling and Installing Switchboards
WISCONSIN--MINNESOTA--IOWA
William C. Strehl
Telephone Expert
P. O. Box 458 La Crosse, Wisconsin

$37.50 **Addressograph**

CHEAPER than typewriter—SAVES 20% of YOUR present costs—5 to 15 times FASTER and BETTER than pen or typewriter.
FREE TRIAL will prove it.
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Everstick

Approved by Large Operating Companies For the Following Strains

6" 2-way	2,200 lbs.
6" 4-way	6,000 lbs.
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8" 4-way	10,000 lbs.
10" 4-way	16,000 lbs.

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Knickerbocker
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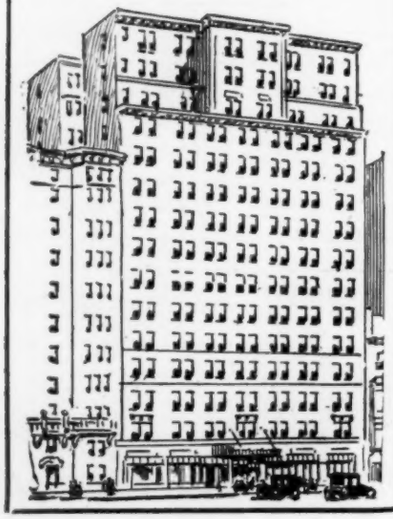
Just East of Broadway, Times Square

New York's Newest Hotel

A location unsurpassed. A few seconds to all leading shops and theatres. Away from the noise and bustle and still convenient to everything. Between Grand Central and Pennsylvania Terminals.

RATES
$3 to $5 per Day
400 Rooms—400 Baths



Armstrong Again Heads Arkansas Association

Eureka Springs, Ark.—K. J. E. Armstrong, Russellville, was re-elected president of the Arkansas Telephone association at its two day annual meeting held here. Other officers elected are: vice president, E. L. McHaney of Piggott, and George Walker of Sheridan; secretary, J. F. Gillespie of Carlisle; directors, Gus Lane of Little Rock, Conrad Elsken of Paris, William Graham of Clarendon and L. M. Emerson of Prescott.

The meeting drew about one hundred telephone men and women who struggled together in close formation, with the problems and aims of the industry. A practical program was offered which scheduled among its feature speakers A. G. Ingalls, president of the local Chamber of Commerce; R. W. Hedrick of Jefferson City, Mo.; L. M. Emmerson, Prescott; E. P. Ladd, Star City; W. E. Mitchell, Waldron; D. B. Anderson, Ozark; J. P. McCord, Greenwood; W. J. Moore of Harrison; Conrad Elsken, Paris; E. G. Greber, Little Rock, division plant superintendent; R. E. Norris, Berryville, and J. M. McKnight, Lewisville.

New Lake Lure (N. C.) Company Boon to Section

Asheville, N. C.—Establishment of the Lake Lure Telephone company, near Chimney Rock, 26 miles southeast of Asheville, has brought to an isolated community means of rapid communication that heretofore have sadly handicapped the entire section. With S. V. Hooker, an experienced man, as manager, the present installation includes a 100-pair cable to serve the village of Chimney Rock. Approximately 150 subscribers have already made application for telephone connections upon the original installation, Mr. Hooker asserts. Upon completion of the new Lake Lure administration building in Lake Lure, North Carolina's newest town, there will be installed by the end of September a main switchboard of 240-line capacity. At Lake Lure Inn, to be completed about September 1, there will also be installed an 80-line switchboard.

Britain's Telephones Show Healthy Growth

London, Eng.—Official statistics show that the additions to England's telephone system during the periods of October, December and January-March were greater than during any other quarters covered by official records. During the year more residence rate subscribers were added to the system than business subscribers, the actual numbers being 39,355 residence-rate and 35,270 business-rate installations. There was a gross increase for the year of 222,494 telephones, counterbalanced by 106,141 cessations, a net growth of 116,353. London showed an increase of 39,111 telephones, a growth of 8.7 per cent. England and Wales (excluding London) increased by 67,541, or 9.9 per cent; Scotland's increase was 8,359, or 6.8 per cent; and Northern Ireland, with a growth of 1,392 telephones, showed a 7.9 per cent increase.

Illincis Independents Group in Big Merger

Joliet, Ill.—Thirteen Illinois Independent telephone companies are drawn into the combination which has been chartered as the Illinois Central Telephone company. Responsible for this merger and figuring in the new grouping as directors are: L. C. Moeszinger and H. G. Barrett, Clinton; A. P. Armington, Dixon; F. W. Potter, Henry T. W. Stehlin, Gillespie, A. T. Vanniman, Girard; C. B. Cheadle and R. M. Matteson, Joliet; Orin Latimer, Abingdon; C. A. Camp, Henry, and W. A. Alexander, Carlinville.

The following companies are included in the consolidation: Sullivan Home Telephone Company, Chillicothe Peoples Telephone Company, Washington Home Telephone Company, Illinois Central Telephone Company, Abingdon Home Telephone Company, Illiopolis Telephone Company, Niantic Telephone Company, Central Telephone Company, Sparland Telephone Company, Macon Telephone Company, Menard Telephone Company, Farmers Telephone Company of Hopedale and the Auburn Telephone Company.

The company, with offices at Joliet, will have preferred stock totaling $650,000 and common stock of $350,000.

Family of H. D. Currier Dies in Motor Crash

Chicago, Ill.—Mrs. H. D. Currier, sons James, 19, and William, 11, and Water Ditchburne, 12, a playmate of the youngest Currier boy, were killed July 23, when the Currier automobile, driven by James crashed into a stalled motor truck without a tail light, on the Dunes Highway, near Gary, Ind. Mrs. Currier and James were killed almost instantly, William died a day after, with the fourth member of the party, young Ditchburne, lingering for a day longer.

This tragedy wiped out the family of H. D. Currier, for many years chief engineer of the Kellogg company and one of the best known figures in the Independent telephone field. Mr. Currier was on a business trip when the accident occurred. Frantic efforts to locate him were unsuccessful until several days after the catastrophe. The bereaved father has the deep sympathy of his host of telephone friends in his terrible misfortune.

Easy to See Why the

UNIQUE FURNACE

is preferred

PATENTED ARRANGEMENTS FOR DISLODGING COIL WITHOUT TEARING DOWN FURNACE
PATENTED SEAMLESS TUBING COIL GENERATOR
IMPROVED ONE PIECE BURNER
HAND HOLD FOR CLEANER ONE TURN CLEANS ORIFICE
AUTOMATIC ORIFICE CLEANER
AUTOMATIC PUMP INSIDE TANK
16 GUAGE STEEL TANK WELDED BOTTOM

Many of the foremost Bell and Independent companies have standardized the Unique Furnace. It melts 50 lbs. of lead in 10 minutes. An automatic orifice cleaner assures continuously efficient operation. It's sturdy and simple.

"UNINTERRUPTED SERVICE"—the result of a "UNIQUE DESIGN and BETTER CONSTRUCTION."

Literature ready—BLOW TORCH and Furnace.

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CHOICE OF THE LEADERS

RECONSTRUCTED EQUIPMENT

American Elec. 6-bar Extra heavy duty Bdg. hand Generators complete @	$ 2.75
Western Electric Co., No. 2-C Ball type Combine line drops and jacks, per strip of 5 @	7.75
Kellogg No. 3 100 ohm series combine line drops and jacks, per strip of 5 @	6.50
Dean or Garford Combine line drops and jacks, mounted 10 per strip 500 or 1000 ohm, per strip @	11.00
Burns No. 45 Express type Combine line drops and jack @	1.35
Western Elec. Co., 2500 ohm Biased ringers with gongs @	1.60
Am. Elec. Co., No. 360 type 3-bar 2500 ohm 4-party compacts with biased ringers @	6.75
American Elec. No. 36 type 5-bar 1600 ohm Bdg. compacts @	7.50
Chicago Telephone Supply Co., 4-bar 1000 or 1600 ohm Bdg. compacts @	6.75
Stromberg No. 500 4-bar 1000 or 1600 ohm Bdg. compacts @	6.90
Stromberg late type 1000 ohm self contained ringers complete less Gongs @	1.20
Mansbridge ½ M. F. Condensers @	.30
Dean No. 240 type 4-bar 1000 or 1600 ohm Bdg. compacts @	6.90
Garford Pony type 4-bar 1600 ohm Bdg. compacts @	8.50
Monarch 4-bar 1000 or 1600 ohm Bdg. compacts @	7.25
Kellogg No. 39 Unbreakable type C. B. desk sets complete with No. 75 Straight line steel signal sets @	6.75
Auto. Elec. Co., 600 ohm Extension bells @	1.25

REBUILT ELECTRIC EQUIPMENT CO.
Not Inc.
E. C. Stoeffhaas, Mgr.
1940 W. 21st Street CHICAGO, ILL.

We are not connected with or successors to Rebuilt Telephone Equipment Co.

Santa Monica (Cal.) to Be in New Home in October

Santa Monica, Cal.—In October the Santa Monica Bay Telephone company's business offices probably will move into its new home which is being rushed to completion. Manager Mason recently stated that transfer of operating equipment to the new building probably would require 9 months longer. The new home of the Santa Monica company is one of the prides of the Bay district. It is a feature of the vigorous progress the company has made under the administration of Mason and his associates.

Columbus, N. Mex.—Columbus Telephone company has bought the Luna County Telephone company.

Nervy Operator Saves Town When Fire Threatens

Tennyson, Ind.—Mrs. Iva Spradley, by climbing a pole with a portable set and connecting with a long distance line after the local telephone exchange had been completely destroyed by fire, summoned help from Evansville and Huntingburg in time to extinguish a fire that threatened Tennyson with extinction. Loss of $60,000 had been incurred prior to the time the heroine was able to get outside help.

Ocheyedan, Ia.—Don V. Wells, representing a syndicate, has bought the exchanges at Ocheyedan, Melvin, Allendorf, Harris and Bigelow.

Speedy!

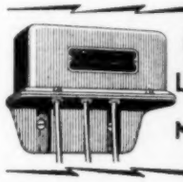
Just loop the wire on and drive. That's the way to install

EUREKA FIBRE INSULATED NAILS

Superior for telephone, telegraph and bell wiring. Uniform, finished appearance. Do not injure woodwork. Furnished in gray or black fibre: polished brass, oxidized or special wire nails; a flexible rubber bushing giving a thick insulation.

Prices and samples on application to

EUREKA SUPPLY CO.
Moorestown, N. J.



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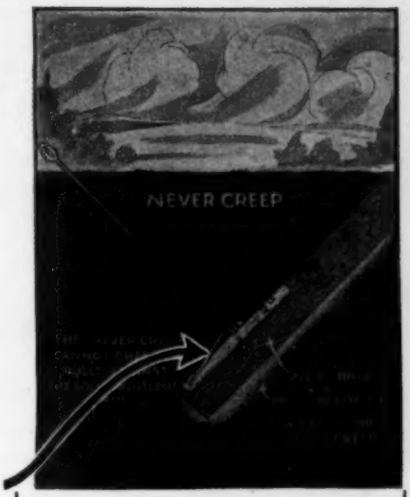
LIGHTNING ARRESTERS
MADE BY
MINNESOTA ELECTRIC CO.
MINNEAPOLIS, MINN.



In *Any* Soil

Never-Creep Anchors

Have Superior Holding Power

In sandy, moist, adobe, or any other soils, the great holding surface of the NEVER-CREEP and its pull against solid, undisturbed earth gives an anchorage that is unsurpassed.

The more you look into anchor construction and performance the more you realize that undisturbed earth to pull against is a vital consideration. Tamping very seldom suffices to give the holding condition an anchor needs. Moisture seeps down to the holding plate of the anchor and collects there with a great sacrifice of the anchor's rigidity. You know how these factors ruin holding power, so play safe by standardizing the NEVER-CREEP and get away from the perils that are bound to come when the earth is disturbed during anchor installation.

The NEVER-CREEP alone has the Thimbleye rod.

Foremost wire companies prefer the NEVER-CREEP. So will you when you learn its complete story. Write us for details.

Chance Company
Centralia, Mo.

Made in Canada by
N. SLATER CO., INC.
Hamilton, Ont.

YOUR BEST BET:
"ALWAYS RELIABLE" TORCHES AND FURNACES

They have been on the market for just **50 years.** During that time they have built up a **wonderful reputation** on quality and merits.

You should use them and receive better results.

Jobbers supply at factory prices.

Covered by Several Patents.
No. 83 QT.
No. 84 PT.
For gasoline.
Fully Guaranteed.

OTTO BERNZ CO. INC.
NEWARK, N. J.
Offices in New York City, Chicago, Fort Worth, Denver, Helena, Mont., San Francisco, Los Angeles, Seattle, and St. Thomas, Ont.

STANDARD
Telephone Cables

are manufactured from the best materials by skilled workmen. They embody the most advanced ideas in telephone cable manufacture.

If interested in dependable cable at a reasonable price, write our nearest office.

Standard Underground Cable Co.

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PHILADELPHIA DETROIT SAN FRANCISCO

The "STEWART" Direct Reading Test Cabinet

Measures shorts, crosses and ground direct in ohms. Resistance to trouble is read off the scale the same as volts off a voltmeter.

Any telephone man can install it and use it. Will save many times its cost in a year.

It costs more to do without the Test Cabinet than to buy one. Write for circular. Sent on trial.

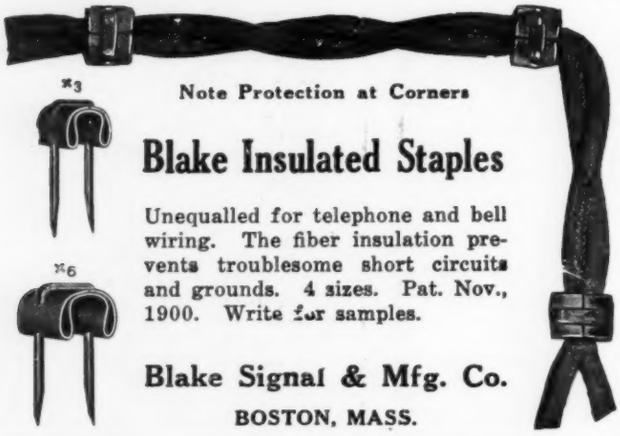
Also, Test Sets, Cable Testers and Detecto-Meters.

STEWART BROTHERS
OTTAWA, ILLINOIS

Exide
BATTERIES

It is significant, in view of the care with which telephone equipment is selected, that Exide Batteries should be the choice of practically every large telephone system in the country.

THE ELECTRIC STORAGE BATTERY CO.
PHILADELPHIA
In Canada, Exide Batteries of Canada, Ltd., 153 Dufferin St., Toronto



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Blake Insulated Staples

Unequalled for telephone and bell wiring. The fiber insulation prevents troublesome short circuits and grounds. 4 sizes. Pat. Nov., 1900. Write for samples.

Blake Signal & Mfg. Co.
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ROY-JAX
Safety TREE TRIMMER

The Roy-Jax trimmer quickly and easily cuts a 6-inch limb. The man on the ground is safe and satisfied. The average weight of the Roy-Jax is 8 pounds, including extension handle.

With the Roy-Jax you get less climbing, perfect insulation, less strain on the men, and the man working away from danger of falling limbs.

Write for complete details of this money- and time-saver.

ROY-JAX CO. AUDUBON, IA.

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Telephone Telegraph Wire

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MEREDITH'S
Multiple and Single Interlocking CREOSOTED WOOD CONDUIT

Can be opened up and placed around cable
3-inch bore, 2 to 12 duct
Single conduit, 2, 2½ and 3-inch bore

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WRITE
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for prices and particulars of Meredith's Single and Multiple Conduit

New Monarch Magno=Fone

The New Monarch
MAGNO-FONE
For Magneto Service

The MAGNO-FONE is the new Monarch Magneto telephone instrument. Do not confuse this new MAGNO-FONE with our new COMO-FONE or common battery instrument. They are similar in outward appearance only.

Combine the compactness, the sturdiness, the ease of handling, the efficiency of operation and the beauty of this new MAGNO-FONE with the durability and operating economy of our upright desk type telephone and you have a magneto telephone instrument unmatched in construction and design.

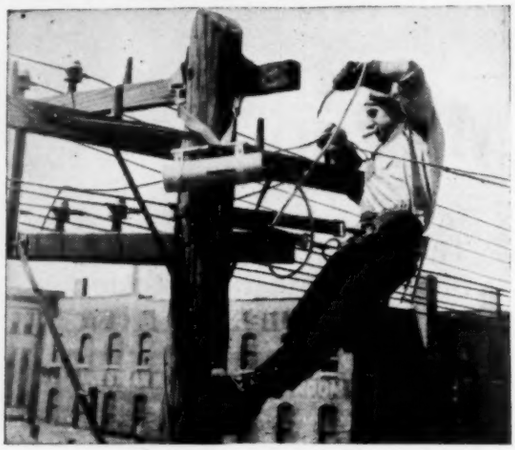
The hand-piece is so well balanced and shaped to the hand that it is exceptionally convenient to lift, to hold in a talking position and replace on the rest. The transmitter cap deflects the voice directly into the transmitter, and when the handpiece is held in a talking position the transmitter is always the proper distance from the lips. When talking one hand is always free.

This new MAGNO-FONE will add to the appearance of the users home or office.

Order several and put them on trial with your subscribers.

MAGNO-FONE
With Hand Piece Removed

Monarch Telephone Mfg. Co.
1027 WEST VAN BUREN ST., CHICAGO, ILL.



No waiting for HEAT with this equipment

When a lineman has the new Prest-O-Lite Heating Equipment, he loses no time waiting for heat. He does not have to do any pumping or generating. Just turns on the gas and the heat he wants is ready instantly.

It does better work and does it faster.

The Prest-O-Lite Soldering Iron is a big improvement over the old-fashioned kind too. It gets hot instantly and it stays hot until the work is done.

The equipment operates on Prest-O-Lite Gas. This means economy and convenience as well, because empty tanks can be exchanged for full ones at any one of the thousands of Prest-O-Lite Service Stations located all over the country. You pay a small amount for the gas only.

We will furnish further details and demonstrate the efficiency of this equipment on request.

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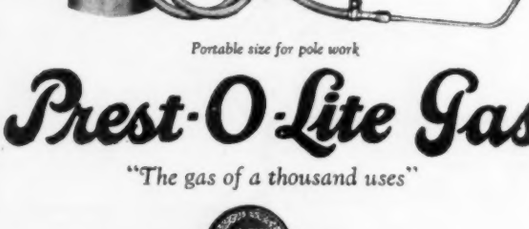
INDIANAPOLIS, IND. Dept. M-9
New York San Francisco
In Canada: Prest-O-Lite Company of Canada, Ltd., Toronto, Ont.



Portable size for pole work

Prest-O-Lite Gas

"The gas of a thousand uses"

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